Proceedings of Sinn und Bedeutung 24
Volume 1

Eds. Michael Franke, Nikola Kompa, Mingya Liu, Jutta L. Mueller, and Juliane Schwab

Osnabrück University
Humboldt University of Berlin
Foreword

We are pleased to put forward this selection of papers based on talks and posters presented at Sinn und Bedeutung 24, which was hosted by the Institute of Cognitive Science and the Institute of Philosophy at Osnabrück University on September 04-07, 2019.

Out of an initial 218 submissions, the organizing committee selected 51 for oral presentations in the main session, 4 for oral presentations in the special session “Neurolinguistic Approaches to Semantics and Pragmatics”, and 23 for posters. Additionally, there were 6 invited talks. The present volume contains papers based on 65 of these contributions.

We would like to thank the many people who have been essential in ensuring the success of SuB24: the reviewers from around the world whose help was indispensable for the success of the conference; the organizers of SuB 22 and SuB 23 (especially Elena Castroviejo), who passed on helpful information, tips, and templates; the invited speakers Chris Barker, Judith Degen, Regine Eckardt, Anastasia Giannakidou, Mante Nieuwland, and Markus Werning; the session chairs, speakers, and of course the audience. We would also like to add special thanks to our dedicated student assistants: Hannah Weber, who was an enormous help to our team by taking care of information collection, website maintenance, and many further minutiae of the conference preparation; Henrique Gianoti, Jonas Kraasch, Nora Maleki, Merlin Marinova, Elisa Palme, Britta Walkenhorst, and Anna Wiedenroth, who provided on-site support during the conference; Birte Spekker and Stephanie Rotter, who worked as editorial assistants in the preparation of the proceedings. Last but not least, we owe further thanks to our colleagues Beate Eibisch and Tatjana Ahrends for supporting us in all administrative matters.

We would also like to thank Sigrid Beck, Paul Dekker, Kai von Fintel, Larry Horn, Hans Kamp, Angelika Kratzer, Manfred Krifka, Louise McNally, and Barbara Partee for sharing with us interesting details about the history of Sinn und Bedeutung, as well as their personal views on the past, present and future of our field.

Finally, we would like to acknowledge financial support from the Deutsche Forschungsgemeinschaft (DFG grant 411046999), the Universitätsgesellschaft Osnabrück, and the Institute of Cognitive Science at Osnabrück University.

We look forward to seeing you all soon at the virtual Sinn und Bedeutung 25, organized by our colleagues from University College London and Queen Mary University of London.

Stay safe in these difficult times!

June 2020,

Michael Franke, Nikola Kompa, Mingya Liu, Jutta L. Mueller, and Juliane Schwab
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Interesting interrogatives
Maayan ABENINA-ADAR — University of California, Los Angeles

Abstract. The stem interest has two syntactic variants that occur with both declarative and interrogative subordinate clauses. The presuppositions that such constructions carry are difficult to explain under predominant theories of how similar predicates semantically compose with subordinate clauses. I offer a new analysis, which puts together some ideas already found in this literature – in particular, the idea that certain interrogative clauses semantically encode (something like) the illocutionary force of asking and the idea that experiencer predicates (such as interest) are associated with acquaintance inferences.

Keywords: emotive-factives, interrogatives, questions, facts, neo-davidsonian semantics.

1. Introduction

Predicates that syntactically combine with both declarative and interrogative clauses, like know, are called ‘responsive’; they raise a question about semantic composition. The question stems from the fact that such predicates do not appear to be ambiguous between one meaning that composes with interrogative-denotations and another meaning that composes with declarative-denotations.

One piece of evidence against an ambiguity between two such denotation is the cross-linguistic robustness of responsive predicates’ subordination patterns. In many languages, there is an predicate that ‘feels like’ English know that productively combines with both declaratives and interrogatives. This is not to be taken for granted. For example, it is not the case that in many languages, there is a predicate that ‘feels like’ English know that productively combines with both DPs and clauses as English know does. Spanish distinguishes saber from conocer, Hebrew distinguishes leda’at from lehakir (both, roughly: ‘know’ vs. ‘be acquainted with’), etc.

Another piece of evidence for responsive predicates’ unambiguousness is gapping. Gapping – as in the second conjunct of Sue is eating candy, and Mary, chips – is subject to identity constraints. This example can only mean Mary is eating chips. As discussed in Sennet (2016), gapping with a word like run leads to oddness (or as he calls it, a judgment of ‘shenanigans’) in a description of the scenario in (1), (1a); (1b) without gapping is not odd in the same way (though there may nonetheless be better ways to describe the given scenario).

(1) William tried to be the head organizer of the Boston marathon, and Brooke tried to participate in the NYC marathon as runner (and did not try to be the head organizer of the NYC marathon).
   a. #William tried to run the Boston marathon, and Brooke, the NYC marathon
   b. William tried to run the Boston marathon, and Brooke tried to run the NYC marathon

The fact that gapping in (2a) is not odd (Uegaki, 2019) suggests that the relation between interrogative-taking know and declarative-taking know is not the same as the relation between run in the sense of ‘be the head organizer’ and run in the sense of ‘move at a pace faster than walking’. Gapping with DP-taking know and clause-taking know is odd, as expected, (2b).

1For helpful judgments and feedback, I thank Alon Adar, Dylan Bumford, Tim Hunter, Oshri Lavi, Ezer Rasin, Jessica Rett, Yael Sharvit, Beth Sturman, Michelle Yuan, and the audience at Sub24. Any errors are mine.

Predominant semantic theories of clausal subordination, based on Hintikka (1969), Hamblin (1973), and Karttunen (1977), typically make the following two assumptions: (i) predicates like know denote functions that take clausal denotations as arguments, and (ii) interrogatives and declaratives have different semantic types. The evidence for know’s unambiguousness raises the following question: how does an unambiguous predicate semantically compose with clausal denotations of different types?

A variety of answers to this question have emerged from works that address other issues in the semantics of clausal subordination. The purpose of this paper is to present a new paradigm that resists explanation by these answers. It involves two syntactic variants of the emotive-factive predicate interest, interesting₁ and interests₂. The basic empirical pattern, shown in (3a-d), is that while both interesting₁ and interests₂ presuppose declarative knowledge, (3a-b), interesting₁ presupposes interrogative knowledge while interests₂ does not, (3c-d).

(3) a. It is interesting₁ to me that I’ll receive a kite for my birthday  
   Presupposes: I know that I’ll receive a kite for my birthday  
   b. It interests₂ me that I’ll receive a kite for my birthday  
   Presupposes: I know that I’ll receive a kite for my birthday  
   c. It is interesting₁ to me what present I’ll receive for my birthday  
   Presupposes: I know what present I’ll receive for my birthday  
   d. It interests₂ me what present I’ll receive for my birthday  
   Does not presuppose: I know what present I’ll receive for my birthday

This perspective on the data is supported by contextual acceptability judgments. (3a)-(3b) are acceptable in contexts where the experiencer has declarative knowledge and are unacceptable in contexts where the experiencer lacks it, (4)-(5).

(4) I (know that I) will receive a kite for my birthday, and…  
   ✓ (3a), ✓ (3b)

(5) I don’t know what present I will receive for my birthday, and…  
   #(3a), #(3b)

In a context where the experiencer has interrogative knowledge, as in (6), (3c)-(3d) are both acceptable. But when the context is modified so that the experiencer lacks interrogative knowledge, as in (7), (3c) with interesting₁ becomes unacceptable whereas (3d) with interests₂ remains acceptable.²

²(i)-(iii) round out the picture. (i) shows that the contrasts in presuppositions is about the experiencer’s knowledge, not necessarily the speaker’s. (ii)-(iii) show that knowledge implications survive negation and polar questioning, confirming their status as presuppositions.

(i) a. It is interesting to Sue what present I’ll receive for my birthday  
   Presupposes: Sue knows what present I’ll receive for my birthday  
   b. It interests Sue what present I’ll receive for my birthday  
   Does not presuppose: Sue knows what present I’ll receive for my birthday

(ii) a. Is it interesting to Sue what present I’ll receive for my birthday?  
   b. It isn’t (particularly) interesting to Sue what present I’ll receive for my birthday  
   Both presuppose: Sue knows what present I’ll receive for my birthday
Interesting *interrogatives*

(6) *I know what present I will receive for my birthday, and . . .*
✓ (3c), ✓ (3d)

(7) *I don’t know what present I will receive for my birthday, and . . .*
#(3c), ✓ (3d)

2. The puzzle

These judgments are not straightforwardly explained by the two predominant approaches to how responsive predicates compose with declaratives and interrogatives. I adopt terminology from George (2011), Uegaki (2015), Elliott et al. (2017), among others, and call these two approaches ‘reductive’ and ‘uniform’.

2.1. The reductive approach

Theories within the reductive approach take for granted that declaratives and interrogative have different semantic types. One standard view is that declaratives denote propositions whereas interrogatives denote intensions of sets of propositions that count as possible answers (e.g. Hintikka, 1969; Hamblin, 1973). Sample clausal denotations are given in (8a-b); I assume that propositions are functions from situations to truth values.

(8) a. \[ \lambda s'. \text{I will get a kite in } s' \]

b. \[ \lambda s. \{ \lambda s'. \text{I will get x in } s' : x \text{ is a present in } s \} \]

Under the reductive approach, responsive predicates select for declarative denotations, (9a); In this respect, they differ from interrogative-only predicates like *wonder*, (9b) (e.g. Lahiri, 2002).

(9) a. \[ \lambda p_{st}. \lambda x. \lambda s: p(s) = 1. \text{Know}(x, p, s) \]

b. \[ \lambda Q_{(s,⟨st,t⟩)}. \lambda x. \lambda s. \text{Wonder}(x, Q, s) \]

What theories that are classified as reductive have in common is that they propose some grammatical means to provide a responsive predicate with a proposition-type argument in subordinate interrogative constructions. One implementation (among others Heim, 1994; Dayal, 1996; Beck and Rullmann, 1999) assumes an answerhood operator, \( \text{ANS} \), which shifts an interrogative-denotation to its answer (the most informative among the true propositions in the set of possible answers, defined only if there is one). Sample declarative and interrogative constructions with the responsive predicate *know* are in (11a-b). \( \rightarrow \) represents material implication and \( \Rightarrow \) represents generalized entailment (e.g. von Fintel, 1999).

(10) \[ \text{ANS} = \lambda s. \lambda Q_{(s,⟨st,t⟩)}: \exists p_{st} \in Q(s)[p(s) = 1 \land \forall q \in Q(s)[q(s) = 1 \rightarrow p \Rightarrow q]]. \]

(iii) a. Is it interesting to Sue that I’ll receive a kite for my birthday?

b. Does it interest Sue that I’ll receive a kite for my birthday?

c. It isn’t (particularly) interesting to Sue that I’ll receive a kite for my birthday

d. It doesn’t (particularly) interest Sue that I’ll receive a kite for my birthday

All presuppose: Sue knows that I’ll receive a kite for my birthday

3 I take a situation to be a proper or improper spatiotemporal part of a possible world (as in (among others) Kratzer, 1989, 2019). Throughout, \( @ \) is an object- and meta-language symbol for the topic situation under discussion. I assume the compositional system and \( \lambda \)-function notation in Heim and Kratzer (1998).

4 Other implementations differ in what grammatical mechanism they propose (e.g. QR in Lahiri 2002, meaning postulates in Karttunen 1977, Spector and Egré 2015). The same issues arise as with ANS.
\[ tp_{st} \in Q(s)[p(s) = 1 \land \forall q \in Q(s)[q(s) = 1 \rightarrow p \Rightarrow q]] \]

(11) a. [Sue [knows [that I will get a kite]]]
    b. [Sue [knows [ANS-@ [what present I will get]]]]

Extending this approach to the analysis of \textit{interesting} \textsubscript{1} and \textit{interests} \textsubscript{2}, we might assign the predicates the general proposition-selecting meanings in (12a-b). Their partiality is motivated by the fact that both variants presuppose knowledge with declarative clauses.

(12) a. \[ \text{[interesting} \textsubscript{1}] = \lambda p_{st}. \lambda x. \lambda s : \text{Know}(x, p(s), \text{Int}(x, p(s)) \text{]} \]
    b. \[ \text{[interests} \textsubscript{2}] = \lambda p_{st}. \lambda x. \lambda s : \text{Know}(x, p(s), \text{Int}(x, p(s)) \text{]} \]

This proposal incorrectly derives interrogative knowledge presuppositions with \textit{interests} \textsubscript{2} as it correctly does with \textit{interesting} \textsubscript{1}. The relevant LFs are in (13a-b).

(13) It \{is interesting} \textsubscript{1} to me, \textit{interests} \textsubscript{2} me\} what present I’ll receive for my birthday
    a. \[ \text{[interesting} \textsubscript{1} [\text{ANS-@ [what present I’ll receive for my birthday]] to me} \]
    b. \[ \text{[interests} \textsubscript{2} [\text{ANS-@ [what present I’ll receive for my birthday]] me} \]

Both presuppose: I know what present I’ll receive for my birthday

To avoid incorrect predictions, a reductive account could posit that \textit{interests} \textsubscript{2} is ambiguous between a proposition-selecting entry like (12b) and a question-selecting entry like (14a) and that both can be used in subordinate interrogative constructions. This would mean that \textit{interests} \textsubscript{2}’s subordinate interrogative constructions are structurally ambiguous between an LF as in (13b) that presupposes knowledge and an LF as in (14b) that does not.

(14) a. \[ \text{[interests} \textsubscript{2}] = \lambda Q_{(s,(st,t))}. \lambda x. \lambda s : \text{Int}(x, Q(s)) \]
    b. \[ \text{[interests} \textsubscript{2} [\text{what present I’ll receive for my birthday] me} \]

While an ambiguity analysis captures the constructions’ knowledge presuppositions in isolation, it is not supported by ambiguity tests like gapping. The gapping example in (15) is acceptable in a context where Sue lacks interrogative knowledge and Mary has declarative knowledge. Under an ambiguity story, this is surprising. The identity constraints associated with gapping are expected to enforce the use of (12b) in both clauses, producing a reading that presupposes that Sue has interrogative knowledge and Mary has declarative knowledge.

(15) Sue doesn’t know what present she’ll receive for her birthday. Meanwhile, Mary knows that Sue won’t be receiving a kite. Thus...

It interests Sue what present she’ll receive for her birthday, and Mary, that it won’t be a kite

2.2. The uniform approach

The uniform approach explains responsive predicates’ flexibility by assigning interrogatives and declaratives the same semantic type and having responsive predicates select for that type. In Groenendijk and Stokhof (1984), both clause types denote intensions of propositions. More recently, in an explicit discussion about compositionality, Elliott et al. (2017) propose that declaratives and interrogatives both denote sets of propositions (see also Theiler et al. (2018) and references therein); in particular, declaratives denote singletons containing their usual Hintikka-proposition and interrogatives denote (intensions of) Hamblin sets, as in (16a-b).
a. \[ \lambda s'. \text{I will get a kite in } s' \] 

b. \[ \lambda x. \{ [\lambda s'. \text{I will get x in } s'] : x \text{ is a present in } s \} \]

Under this theory, responsive predicates can be assigned denotations that do not predict interrogative knowledge based on declarative knowledge; the predicates ‘access’ an unadulterated interrogative-denotation.

(17a-b) are extensions of this approach to \textit{interests}_2 and \textit{interesting}_1 (\textit{interest}_2 is inspired by the analysis of \textit{care} in Elliott et al. (2017)). The two predicates differ in their presuppositions. Suppose the meta-language relation \textit{Know} takes proposition arguments, and having clausal knowledge means standing in the \textit{Know}-relation to at least one member of the clause’s set denotation. Given a singleton proposition set (i.e. a declarative denotation), both (17a-b) produce a knowledge presupposition, but given a non-singleton (i.e. an interrogative denotation), interrogative knowledge can be inferred from (17a) but not (17b). The relevant LFs are in (18a-b)

(17) a. \[ \text{interesting}_1 = \lambda Q_{(st,t)}. \lambda x. \lambda s : \exists p \in Q [\text{Know}(x,p,s)] \cdot \text{Int}(x,Q,s) \] 
b. \[ \text{interests}_2 = \lambda Q_{(st,t)}. \lambda x. \lambda s : \text{Know}(x,[\lambda s'. \exists p \in Q [p(s') = 1], s]) \cdot \text{Int}(x,Q,s) \]

(18) It \{is interesting to me, interests me\} what present I’ll receive for my birthday

a. \{interesting\}_1 \{[what present I’ll receive for my birthday]-@\} to me

Presupposes: I know what present I’ll receive for my birthday (i.e. there is at least one possible answer that I know)

b. \{interests\}_2 \{[what present I’ll receive for my birthday]-@\} me

Presupposes: I know that I’ll receive a present for my birthday (i.e. I know that there is at least one true possible answer)

This uniform analysis runs afoul of further ambiguity tests. \textit{Interesting}_1 and \textit{interests}_2 can occur with individual-denoting expressions\(^5\), as in (19a-b).

(19) a. Bill’s clothing interests me

b. Bill’s clothing is interesting to me

Ellipsis data like (20a-b) suggest that one lexical entry is used in clause- and individual-taking constructions. This is somewhat at odds with this sketch of a uniform analysis, which treats such predicates as intrinsically selecting for clausal denotations and encoding rather detailed presuppositions about what to do with those denotations.

(20) a. That Bill cuts his own hair interests me, and his clothing does too

b. That Bill cuts his own hair is interesting, and his clothing is too

2.3. Towards an analysis

Straightforward extensions of existing theories do not readily explain the knowledge inferences and ambiguity test results that we observe with \textit{interesting}_1 and \textit{interests}_2. This investigation has shown that a theory that captures i.-iii. is needed.

i. Responsive predicates compose with interrogatives in a way that does not necessarily produce interrogative knowledge on the basis of declarative knowledge

\(^5\)\text{Bill’s clothing}, unlike, e.g., \text{Bill’s height}, does not appear to license a concealed question reading.
ii. *Interesting*$_1$ and *interests*$_2$ have an entry that is uniformly used across the various constructions they occur in

iii. Knowledge is presuppositional and is obligatory with declaratives and with *interesting*$_1$’s interrogatives

3. Proposal

The basic theoretical intuition I pursue (with non-technical uses of the terms ‘question’ and ‘answer’) is that when *interesting*$_1$ occurs with an interrogative clause, what is ‘interesting’ is the interrogative’s answer. In contrast, when *interests*$_2$ occurs with an interrogative clause, what ‘interests’ can be either the answer or the question itself.

Because both predicates are experiencer predicates, they license acquaintance inferences; these are inferences that the experiencer has the prerequisite perceptual experience of the stimulus to evaluate whether it has the property associated with the predicate. For example, we generally infer from (21a-b) that Mary has tasted the cake, and we generally infer from (22a-d) that Mary has the relevant perceptual experience of Bill’s clothing.

(21) a. The cake is tasty to Mary
b. The cake isn’t tasty to Mary

(22) a. Bill’s clothing is interesting to Mary
b. Bill’s clothing isn’t interesting to Mary
c. Bill’s clothing interests Mary
d. Bill’s clothing doesn’t interest Mary

I propose that as a result of acquaintance, we can infer from *interesting*$_1$ with an interrogative clause that the experiencer has knowledge of the answer (which is what *know* with an interrogative clause means). In contrast, the possibility of a question reading for an interrogative with *interests*$_2$ renders interrogative knowledge inferences invalid; being acquainted with a question does not guarantee knowing its answer.

Under standard assumptions, where questions are simply sets of answers, this theoretical intuition is difficult to express coherently. To spell it out, I draw on works that have proposed that the illocutionary force of asking is sometimes part of the grammatically-determined meaning of an interrogative clause (among others Krifka, 1999, 2001; Sauerland and Yatsushiro, 2017). I call this richer meaning of an interrogative, which arises with *interests*$_2$ but not with *interesting*$_1$, an ‘inquiry’. I continue to use the term ‘question’ for a set of possible answers and ‘answer’ for a member of this set (or the maximally informative among the true members of this set).

3.1. Neo-Davidsonian attitude semantics

Recent semantic work on subordinate clauses, inspired by Neo-Davidsonian event semantics, proposes that predicates and clauses denote properties of events and compose intersectively, as sketched in (23) (for motivation see among others Kratzer, 2006; Moulton, 2009; Moltmann, 2013; Bogal-Allbritten, 2016).

(23) \[ \exists e[[\text{clause-taking verb}](e,\ @) \land [[\text{clause}](e,\ @) \land \ldots]] \]
Furthermore, it has been proposed that subordinate clauses can serve several kinds of thematic event-roles: (i) they may specify the propositional content of the event or of one of its participants (among others Kratzer, 2006; Moulton, 2009; Moltmann, 2013; Bogal-Allbritten, 2016), or (ii) they may specify the cause of the event (Hartman, 2012). According to the diagnostics in Hartman (2012) (based on Pesetsky, 1995), *interest* is a causative predicate.\(^6\) To flesh out the semantic proposal in Hartman (2012), I assume that clauses with causative predicates like *interesting*\(_1\) or *interests*\(_2\) contribute that the cause of the event is a Kratzerian ‘fact’ (Kratzer, 1989, 2012, 2019). According to Kratzer, a fact is defined as a situation (i.e. a part of a possible world) that exemplifies a proposition (i.e. contains all and only the parts of the possible world necessary to make the proposition true). The definition of exemplification is in (24).

\[(24) \text{Exemplify}(s, p) \iff \exists s' \subseteq s[p(s') = 0] \rightarrow [p(s) = 1 \land \neg \exists s' \sqsubseteq s[p(s') = 1]]\]

(\(p\) is true in \(s\) and all of its parts, or \(p\) is true in \(s\) and in none of its proper parts)

\[(25) \text{a. It is interesting to me that I will receive a kite} \]
\[\text{b. When defined, } [(25a)](@) = 1 \text{ iff } \exists e[\text{Interest}(e, @) \land \text{Cause}(e, @)] =
\]
\[t s' \sqsubseteq @[\text{Exemplify}(s', [\lambda s''. I \text{ will receive a kite in } s''])] \land \text{Exp}(e, @) = \text{Me}]
\]

‘There was an event of interest caused by the fact (exemplifying the proposition) that I will receive a kite and it was experienced by me’

3.2. Denotations and getting knowledge

I propose to account for knowledge inferences with *interesting*\(_1\) and *interests*\(_2\), when they arise, as acquaintance inferences that are observed more generally with subjective experiencer predicates, such as *tasty*, *fun*, and *seem*. How exactly these inferences should be accounted for is a complex question (see Ninan (2014), Anand and Korotkova (2018) for discussion). For simplicity, I assume (inspired, among others, by Pearson, 2013) that *interesting*\(_1\) and *interests*\(_2\) directly encode a presupposition that the participants of the event they describe stand in an acquaintance relation, Acq. A major component of the proposal that remains to be developed is an explanation of what propositional knowledge the experiencer can be inferred to have based on acquaintance. I will refer to this further knowledge as ‘extended acquaintance’ and will point out what inferences are assumed to be derived by it. The account currently rests on the assumption that a theory of extended acquaintance can be developed that produces the desired

---

\(^6\)One diagnostic is that nominalizations based on causative clause-taking verbs are degraded compared to nominalizations based on content/subject-matter clause-taking verbs; *interest* contrasts with *believe*, (i)-(ii).

(i) a. It interests Sue that it’s raining
   b. ??Sue’s interest that it’s raining is unexpected

(ii) a. Sue believes that it’s raining
   b. Sue’s belief that it’s raining is unexpected

\(^7\)The same proposal be expressed with *interesting*\(_1\), *interests*\(_2\) denoting functions with clausal denotations in their domain. This would be a ‘uniform’-style analysis; since clauses with *interest* are assumed to receive a fact denotation, the type-distinction between expressions like Bill’s clothing and that Bill cuts his own hair (and, I propose, *what present I will get*) is in some sense neutralized. I adopt the Neo-Davidsonian approach merely for exposition.
results.

(26) sketches the LF and the composition of a declarative construction, showing the part of the clause that is involved in deriving an eventuality-property. I am assuming that functional material inside the clause that I will receive a kite can produce a fact denotation (i.e. $ts \sqsubseteq @[[Exemplify(s, [\lambda s'. I will receive a kite in s'])]]$, and that all event-role assignment takes place via syntactic functional heads like Cause and Exp; in addition to contributing what thematic role their syntactically-associated argument bears, they presuppositionally track event participants with meta-language labels like Part(icipient) A or Part(icipient) B. The presuppositions of content words like interesting$_1$ and interesting$_2$ can then reference these labels. The event properties compose intersectively$^8$ and are the input to the presuppositional existential closure function in (26d) (inspired by Beaver (2001)), which produces the presupposition in (26e).

(26) LF: Closure$^3$ [[Cause [that I will receive a kite]] [interesting$_1$ [Exp [me]]]]

a. [Cause] = $\lambda x. \lambda s. \lambda e : \text{PartB}(e, s) = x$. Cause$^t(e, s) = x$

b. [Exp] = $\lambda y. \lambda s. \lambda e : \text{PartA}(e, s) = y$. Experiencer$^t(e, s) = y$

c. [interesting$_1$/interesting$_2$] = $\lambda s. \lambda e : \text{Acq}(\text{PartA}(e, s), \text{PartB}(e, s), s)$. Interest$^t(e, s)$

d. [Closure$^3$] = $\lambda P,(\sigma, \delta) : \exists x_{\delta}[\langle P(s)(x) \rangle]$ is defined.

e. [(26) [@]) is defined only if $\exists e[\text{PartB}(e, @) = ts \sqsubseteq @[[\text{Exemplify}(s, [\lambda s'. I will receive a kite in s'])]].$]

Interesting$_1$ and interesting$_2$ with a declarative are predicted to be felicitous in a context only if the context provides (or can accommodate) acquaintance, i.e. that the experiencer is acquainted with the fact exemplifying the relevant proposition (e.g. that I will receive a kite). In this case, I assume that extended acquaintance produces a presupposition that I believe the proposition. Inspired by Kratzer (2002) (where declarative knowledge ascriptions are analyzed as de re belief ascriptions where the res is a fact), this is what I take know that to mean.

3.3. Interrogative clauses and knowledge

Extending this Neo-Davidsonian causative semantics to interrogatives, I propose that interrogatives may contribute event descriptions as well (see Rawlins, 2013; Elliott, 2017: §3 for related proposals). Additionally, I propose that there are at least two kinds of interrogative clauses – hence at least two interrogative readings – that occur with causative predicates: ‘resolved’ and ‘inquisitive’. A ‘resolved’ interrogative contributes that the cause of the event is the fact that exemplifies an answer, derived by applying (26a) to (27a). An ‘inquisitive’ interrogative contributes that the cause of the event is what I call an ‘inquiry’, (27b), which is a situation that does not exemplify an answer but that would exemplify an answer if it progressed normally.

(27) [[what present I will get]] (@)

a. Resolved reading

\[ts \sqsubseteq @[\exists p \in Q(\@)[\text{Exemplify}(s, p)]]\]

b. Inquisitive reading

\[ts \sqsubseteq @[\neg \exists p \in Q(\@)[\text{Exemplify}(s, p)] \land \text{Norm}(s, @) \subseteq \{s' : \exists p \in Q(\@)[\text{Exemplify}(s', p)]\}]\]

$^8$I am assuming an intensional predicate modification rule as in (i).

(i) For any tree $\alpha$ whose daughters are $\beta_{(\lambda x, \delta)}$, and $\gamma_{(\lambda x, \delta)}$, $[\alpha]$ is defined iff $[\beta]$ and $[\gamma]$ are defined. When defined, $[\alpha] = \lambda s, x_{\delta} : [\beta](s)(x) \text{ is defined } \land [\gamma](s)(x) \text{ is defined}$. $[\beta](s)(x) = [\gamma](s)(x) = 1$
\[ Q = \lambda s. \{ [\lambda s'. I \text{ will get } x \text{ in } s'] : x \text{ is a present in } s \} \]

\[ \text{Norm}(s', s) = \{ s' : \text{the norms of } s' \text{ in } s \text{ are satisfied in } s'' \} \]

(based on priority modality in Portner (2009), normative projection in Kratzer (2015))

When an interrogative with \textit{interesting}_1 or \textit{interests}_2 has a resolved reading like (27a), we derive a presupposition that the experiencer is acquainted with the fact exemplifying an answer. Here, I assume that extended acquaintance gives us that the experiencer believes the answer that the fact exemplifies. Inspired by Kratzer (2002), this is what I take an interrogative knowledge construction to mean. In contrast, with an inquisitive interrogative, acquaintance gives us that the experiencer is acquainted with a situation that doesn’t exemplify any answer and that normally progresses to exemplify an answer. In this case, I assume that whatever can be inferred about an individual’s beliefs who is acquainted with an inquiry, it is not belief of an answer. Indeed, given observations about Hebrew in Section 4.2, extended acquaintance should be an ignorance presupposition.

The final step of the analysis is to constrain the kinds of interrogatives that each variant can occur with. For now, I stipulate (e.g. by syntactic selectional restrictions) that \textit{interesting}_1 occurs only with resolved interrogatives and \textit{interests}_2 occurs with both resolved and inquisitive interrogatives. Assuming that fact-denoting declaratives are unambiguous, we get that both variants presuppose declarative knowledge, but with interrogatives, \textit{interesting}_1 necessarily presupposes interrogative knowledge whereas \textit{interests}_2 is ambiguous: one reading, derived with a resolved interrogative, presupposes interrogative knowledge, and the other reading, derived with an inquisitive interrogative, does not.

Before returning to how to constrain the distribution of these two interrogative readings, I consider how the Neo-Davidsonian approach is consistent with the gapping and ellipsis facts.

### 3.4. Unified entries for gapping and ellipsis

The fact that \textit{interests}_2 is able to undergo gapping and ellipsis is problematic for an account that relies on ambiguity to capture the predicate’s diverse inference patterns and combinatorial flexibility. To recap, gapping with \textit{interest}_2 is acceptable in (28), despite one conjunct requiring declarative knowledge but the other conjunct not requiring interrogative knowledge. Also, ellipsis is possible with both \textit{interests}_2 and \textit{interesting}_1 when they occur with a clause in one conjunct and an individual-denoting expression in the other, (29a-b).

(28) It interests Sue what present she’ll receive, and Mary, that it won’t be a kite  
Presupposes: Mary knows that it won’t be a kite  
Does not presuppose: Sue knows what present she’ll receive

(29) a. That Bill cuts his own hair interests me, and his clothing does too  
b. That Bill cuts his own hair is interesting, and his clothing is too

The Neo-Davidsonian account presented in the previous section satisfies most of the proposed syntactic-semantic identity conditions on gapping/ellipsis. For example, (30)-(31) have matching subconstituents with identical meanings, namely, the event description contributed by \textit{interests}; (30) is the LF of (28), and (31) is the LF of (29a) ((29b)’s is identical, just swapping \textit{interesting}_1 for \textit{interests}_2). Strikeout represents gapping/ellipsis.

(30) \begin{center} [\text{Closure}^2 \text{ [[Cause [what present she’ll receive}_{\text{inquisitive}}]] \text{ [interests}_2 \text{ [Exp [ Sue ]]]}] \end{center}
and [Mary λ1 [[Cause [that it won’t be a kite]] [interest1₂ [Exp [t1]]]]]

(31)  [Closure² [[Cause [that Bill cuts his own hair]] [interests₂₂ [Exp [me]]]]

and [[Cause [his clothing]] [interests₂₂ [Exp [me]]]]

Under the present account, interesting₁ and interests₂ contribute very little grammatically-visible information; they both denote event descriptions, which are shared across all their uses.

4. Discussion

What are the consequence of assuming that interrogatives can in principle have resolved and inquisitive readings? Are there precedents for this idea?

4.1. Constraining the readings

I have posited two readings for interrogatives and assumed that interesting₁ and interests₂ differ in what kinds of interrogatives they occur with. This helps to explain when knowledge can and cannot be inferred, along with the licensing of ellipsis and gapping. However, assuming an intrinsic ambiguity in interrogative clauses, without further constraints, overpredicts readings.

Though there are some subtleties that need to be considered, a naive extension would have know with a resolved interrogative mean that the experiencer is acquainted with the fact that exemplifies an answer, and by extended acquaintance, believes the answer. Arguably, this is an adequate meaning for an interrogative knowledge ascription. However, it is not clear what know with an inquisitive interrogative would mean, but it is unlikely that we would want such a meaning to be derivable.

The distribution of the two readings could be constrained by assigning predicates and clauses semantic presuppositions that restrict their compatibility (albeit in a highly stipulative way). Perhaps certain predicates (e.g. know, interesting₁) carry presuppositions that contradict presuppositions carried by inquisitive interrogatives, producing event properties whose presuppositions are unsatisfiable.⁹ Other predicates (e.g. wonder, ask) might carry presuppositions that contradict presuppositions carried by resolved interrogatives, ruling out such combinations. Such an account would imply that interesting₁ and interests₂ do not have the exact same meaning, as assumed before; interesting₁’s presupposition restricts the interrogatives it combines with to be resolved, whereas interests₂’s presupposition is compatible with the presuppositions of both resolved and inquisitive interrogatives.

I now turn to some facts from Hebrew, where the translation of interest also has two variants, but whose meanings differ from those of English interest. The difference between languages perhaps suggests the need for a different way to think about the combinatorial constraints.

9For example, partial event properties like in (ia-b), composed by the intensional PM rule in footnote (i), necessarily have no elements in their domain, producing a necessary presupposition failure with the existential closure function in (26d). This could be seen as a source of ungrammaticality.

(i)  a. λs.λe: Resolving (PartB(e,s)) ∧...
    b. λs.λe: ¬Resolving (PartB(e,s)) ∧...
4.2. The picture from Hebrew

In Hebrew, the root for interest, /p\-\(\text{i}\)-\(\text{a}\)-\(\text{i}\)-\(\text{a}\), also has two syntactic variants. Their difference is most clearly seen in past tense sentences like (32a-b). Me\(\text{?}\)anjen\(_1\), an adjective, occurs with a past copula, whereas \(\text{?}\)injen\(_2\), a verb, inflects for tense directly. Note that me\(\text{?}\)anjen\(_1\) is incompatible with an accusative object, whereas \(\text{?}\)injen\(_2\) requires one.

\[
\begin{array}{ll}
(32) & a. \text{ha-sefer haja me\(\text{?}\)anjen}\(_1\) (*oti) \\
& \text{the-book be.pst interesting}_1 \text{ 1sg.acc} \\
& \text{‘The book was interesting’} \\
& b. \text{ha-sefer } \text{?}\text{injen}\(_2\) *(oti) \\
& \text{the-book interest}_2 \text{.pst 1sg.acc} \\
& \text{‘The book interested me’}
\end{array}
\]

In present tense, the two forms look identical; however, the existence of two variants can be inferred from acceptability both with and without an accusative object, (33a-b).

\[
\begin{array}{ll}
(33) & a. \text{ha-sefer me\(\text{?}\)anjen}\(_1\) \\
& \text{the-book interesting}_1 \\
& \text{‘The book is interesting’} \\
& b. \text{ha-sefer me\(\text{?}\)anjen}\(_2\) oti \\
& \text{the-book interests}_2 \text{ 1sg.acc} \\
& \text{‘The book interests me’}
\end{array}
\]

Both variants are responsive. In combination with declarative clauses, as in (34a-b), both variants presuppose knowledge.

\[
\begin{array}{ll}
(34) & a. \text{me\(\text{?}\)anjen}\(_1\) fe\-ani ekabel afifon la jom huledet \\
& \text{interesting}_1 \text{ that-1sg.nom will.receive kite for.the birthday} \\
& \text{‘It’s interesting that I will receive a kite for my birthday’} \\
& b. \text{me\(\text{?}\)anjen}\(_2\) oti fe\-ani ekabel afifon la jom huledet \\
& \text{interests}_2 \text{ 1sg.acc that-1sg.nom will.receive kite for.the birthday} \\
& \text{‘It interests me that I will receive a kite for my birthday’}
\end{array}
\]

Both presuppose: I know that I will receive a kite for my birthday

But when occurring with an interrogative, neither variant presupposes knowledge. Indeed, both variants appear to presuppose ignorance, as illustrated by the unacceptability of (35a-b) in the provided context.

\[
\begin{array}{ll}
(35) & \text{ani jodea ejze matana ani ekabel la jom hulede} \text{t ve. . .} \\
& \text{I know present I will receive for my birthday and . . .} \\
& a. \#\text{me\(\text{?}\)anjen}\(_1\) ejze matana ani ekabel la jom huledet \\
& \text{interesting}_1 \text{ what present 1sg.nom will.receive for.the birthday} \\
& b. \#\text{me\(\text{?}\)anjen}\(_2\) oti ejze matana ani ekabel la jom huledet \\
& \text{interests}_2 \text{ 1sg.acc what present 1sg.nom will.receive for.the birthday} \\
& \text{Both, roughly: ‘I wonder what present I will receive for my birthday’}
\end{array}
\]

\(^{10}\) (32a) with an accusative object has a present counterfactual reading (i.e. ‘the book would interest me’), formed with a past copula and me\(\text{?}\)anjen\(_2\), the participle of the verb. It is not a counterexample to the empirical generalization that the adjective is incompatible with accusative objects.
In this regard, Hebrew differs from English; (36) repeats the judgment from the introduction that in English, *interesting*<sub>1</sub> and *interests*<sub>2</sub> are acceptable in a context where the experiencer has interrogative knowledge.

(36) *I know what present I will receive for my birthday, and...*
    a. It is interesting<sub>1</sub> to me what present I will receive for my birthday
    b. It interests<sub>2</sub> me what present I will receive for my birthday

The analysis in the preceding section can be extended to Hebrew by assuming that in Hebrew, both variants are restricted to occur only with inquisitive interrogatives. If inquisitive interrogatives produce ignorance presuppositions,<sup>11</sup> then the infelicity of (35a-b) could be seen as a result of presupposition failure in the provided context. In contrast, both variants in English can occur with resolved interrogatives, whose knowledge presuppositions are satisfied in (36).

Or, perhaps the difference between languages reduces to a difference in conceptual range. Crosslinguistically, content words – even those that appear to be translational equivalents – have different conceptual ranges. An example from (Borer, 2005: 12) is English *cat* and Hebrew *zatul*. The former can be used to describe domesticated felines, lions, and tigers (e.g. *the great cats*), whereas the latter only describes domesticated felines. English *ask* and Hebrew *faʾal* are another example. As shown in (37a), *ask* occurs with both interrogatives and declaratives, the latter conveying a meaning like *request*. In contrast, Hebrew *faʾal* is incompatible with declaratives and has no *request*-reading, (37b).

(37) a. She asked me (whether) to invite you
    b. hi faʾala oti *(im) lehazmin otya
        3sg.nom.f asked 1sg.acc whether to.invite 2sg.acc.m
        Well-formed sentence: ‘She asked me whether to invite you’

One way to understand the difference between *ask* and *faʾal* is to say that the former’s conceptual range covers events of requesting action and commitment, whereas the latter’s covers only events of requesting commitment. Extending this line of thought to *interest*, English *interesting*’s conceptual range only covers events caused by resolving facts, not inquiries, whereas *interests*’s range is broader. In contrast, the conceptual range of both variants of Hebrew *meʾanjen* only covers events caused by inquiries. If one has a theory of conceptual range (that is not based on semantic presuppositions), perhaps this could form the basis of an alternative to an account based on semantic presuppositions encoding selectional constraints.

4.3. Inquisitive readings

There is precedent for the idea that interrogative clauses sometimes denote something other than a set of possible answers (or other than the maximally informative true answer). An extension of Ross’s (1970) ‘performative hypothesis’ for declaratives to interrogatives would imply that interrogatives contain a silent *I ask*, an idea that has been explicitly pursued by some authors. For example, Sauerland and Yatsushiro (2017) propose that the ‘remind me’ reading of *again* in (38) is derived by having *again* trigger a repetition presupposition above a

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<sup>11</sup>Examples like (i) can be felicitous when some parents have interrogative knowledge and others do not (Omar Agha (p.c.)), suggesting that *interests*<sub>2</sub>’s interrogative is underspecified rather than ignorance-inducing.

(i) *It interests every parent what their child is doing (and some of them already know)*
syntactically represented, compositionally complex I ask-constituent.

(38) What is your name again?
    ‘Remind me’ reading: I ask that you make it once again known what your name is

Krifka (1999, 2001) makes similar assumptions to explain pair-list readings of quantifiers in matrix interrogatives like (39).

(39) Who did every dog bite?
    Pair-list reading: For every dog $x$, I ask that you make it known who $x$ bit

To my knowledge, Krifka is the first to propose that certain subordinate interrogatives also encode asking, doing so in order to explain contrasts in the availability of high scope readings for quantifiers in subordinate interrogatives observed by Szabolcsi (1997). A basic summary of Szabolcsi’s findings is that in matrix interrogatives, universal quantifiers like $\textit{every} \ NP$ contrast with modified numeral quantifiers like $\textit{more than three} \ NP$, etc. in that only the former make available a pair-list reading. She reports that speakers are not inclined to answer (40) with a list consisting of at least four dog-person pairs.

(40) Who did more than three dogs bite?

In subordinate interrogatives, the availability of a pair-list reading is conditioned not just by the type of quantifier but also by the type of predicate. What Szabolcsi calls ‘extensional predicates’, following Groenendijk and Stokhof (1984), allow pair-list readings for all kinds of quantifiers; this is shown with find out in (41) (data based on Szabolcsi, 1997).

(41) Context: We are investigating who each neighborhood dog has bitten to see which dog is the most dangerous. We confer to see who collected information on more dogs.
    A: I found out who exactly two dogs bit
    B: I found out who more than three dogs bit

A’s utterance has a reading along the lines of ‘exactly two dogs are such that I found out who each of them bit’, and B’s has a reading along the lines of ‘More than three dogs are such that I found out who each of them bit’. These readings are responsible for establishing that B gathered information on more dogs than A did.

In contrast, what Szabolcsi calls ‘intensional predicates’, again following Groenendijk and Stokhof (1984), exhibit the same pattern as matrix interrogatives in only allowing pair-list readings for universals. This is shown with the intensional predicate wonder in (42).

(42) Context: We are investigating who each neighborhood dog has bitten to see which dog is the most dangerous. We confer to see who collected information on fewer dogs.
    A: #I am still wondering who exactly two dogs bit
    B: #I am still wondering who more than three dogs bit

A’s utterance does not have a reading along the lines of ‘exactly two dogs are such that I am still wondering who each of them bit’, and B’s does not have a reading along the lines of ‘more than three dogs are such that I am still wondering who each of them bit’; if they did have these readings, the discourse would establish that B gathered information on fewer dogs (given the ignorance implication of wonder). Instead, the discourse does not cohere.
A sketch of Krifka’s explanation is that in matrix clauses, the *I ask*-operator provides a scope site for quantificational expressions, but given its semantics, it yields a coherent meaning only with universals. Subordinate interrogatives under predicates like *wonder* provide this same scope site and as a result exhibit the same constraints as matrix interrogatives. As for why extensional predicates produce more scope possibilities, and why these are not possibilities with *wonder*, more needs to be said – see Krifka (1999, 2001) for discussion, along with Moltmann and Szabolcsi (1994).

A full comparison between my proposal for inquisitive interrogatives and Krifka on embedded asking is beyond the scope of this work, and certain aspects of our proposals are incompatible (e.g. Krifka’s proposal that the meaning of an asking acts does not return a truth value). However, one prediction is worth mentioning. By relating the lack of knowledge implications to an inquiry reading (which one might equate to Krifka’s embedded asking), a potential prediction is that ignorance correlates with an absence of high scope readings. A relevant contrast is given in (43a-b), containing *interests*$_2$. By providing that I have knowledge, (43a) is meant to induce a resolved reading, and by providing that I am ignorant, (43b) is meant to induce an inquisitive reading; there appears to be a contrast.

(43) a. There are 10 dogs, I have found out who each of them bit, and the information I’ve gathered about five of the dogs interests me. Thus…
   It interests me who more than three dogs bit

   b. There are 10 dogs, I don’t know who any of the dogs bit, and for five of the dogs, I am interested to know who each of them bit. Thus…
   #It interests me who more than three dogs bit

It remains to be seen what kind of theory can capture the correlation between knowledge presuppositions and the availability of pair-list readings.

5. Conclusion

The inferences that *interesting*$_1$ and *interests*$_2$ license and fail to license with interrogatives are challenging for standard compositional analyses developed on the basis of other predicates. I have proposed an analysis that integrates the ideas that ‘asking’ can be embedded and that experiencer predicates are associated with acquaintance inferences. The major questions the analysis leaves open are how acquaintance produces the extended acquaintance inferences I have assumed and how constraints on different interrogative readings should be encoded.

References


Interesting *interrogatives*


Non-resolving responses to polar questions: A revision to the QUD theory of relevance

Omar AGHA — New York University
Alex WARSTADT — New York University

Abstract.

The influential Question Under Discussion (QUD) theory of discourse (Roberts, 2012) formalizes Grice’s notion of relevance. In this paper, we identify a class of relevant discourse moves where Roberts’s account undergenerates, and propose a more inclusive definition of relevance. For example, if asked Should we cancel the picnic?, one can reply If it rains without fully resolving the question. However, in Roberts’s theory, all relevant responses to polar questions are predicted to fully resolve the question because a relevant answer must eliminate at least one alternative in the QUD. We propose that a non-resolving response to a polar question is relevant if it eliminates a set of worlds that overlaps with only some alternatives in the QUD. The new account turns out to make good predictions in the domain of polar questions, and beyond.

Keywords: relevance, QUD, partial answers, discourse, questions.

1. Introduction

The idea that discourse is structured according to Questions Under Discussion (QUDs; Roberts, 2012) has been widely adopted in semantics and pragmatics. In recent years, the notion of a QUD has proven central in the analysis of phenomena as diverse as focus-sensitivity (Beaver and Clark, 2008), presupposition projection (Simons et al., 2010), discourse particles (Rojas-Esponda, 2014), and donkey anaphora (Champollion et al., 2019), to name a few. One of the strengths of Roberts’s (2012) theory is its formalization of the notion of contextual relevance in terms of the comparatively well-understood semantics of questions as denoting sets of alternatives (see Hamblin, 1973; Groenendijk and Stokhof, 1984; Ciardelli et al., 2018).

Despite the centrality of the QUD theory, there has been surprisingly little empirical evaluation of its key predictions regarding relevance (though see Hyska (2015) for related discussion). In this paper, we show that Roberts’s (2012) account of relevance systematically undergenerates in several cases. The primary challenge comes from relevant responses to polar questions that do not fully resolve the question, as in (1). Under that theory, only partial answers to the current QUD can be relevant. Partial answers are answers that move the discourse toward a more informed state by eliminating alternatives. However, despite being intuitively relevant, answer A in (1) does not eliminate any alternatives to the QUD, since it leaves open whether the picnic should be canceled in the event it does not rain.

(1) Q: Should we cancel the picnic?  
A: If it rains.

In fact, Roberts’s (2012) partial answer theory of relevance wrongly predicts that any relevant response to a polar QUD must fully resolve the question. This is because the notions of partial

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1 We would like to thank Lucas Champollion, Aurore Gonzalez, Paloma Jeretič, Karoliina Lohiniva, Craig Roberts, and audiences at SYNC and Sinn und Bedeutung 24. All mistakes are our own.

answer and resolving answer turn out to be equivalent for polar questions.

If the QUD is a wh-question, one can (usually) eliminate an alternative without resolving the question. For example, in (2), answer A is predicted to be relevant because it eliminates from the QUD any alternatives where neither Jane nor Sue ate the cookies, while leaving behind alternatives where Jane did and Sue didn’t, or Sue did and Jane didn’t, or both did. Whereas A1 eliminates an alternative, A2 does not, and thus fails to be relevant.

(2) Q: Who ate the cookies?
   A1: Jane or Sue did.
   A2: # Jane baked the cookies.

Polar questions, on the other hand, contain only two alternatives. If $p$ is a proposition, then the polar question $\ ?p$ has alternatives $\{p, \neg p\}$. Eliminating either alternative from the context fully resolves the question: If $p$ is eliminated the then $\neg p$ is entailed, and if $\neg p$ is eliminated then $p$ is entailed. This is the underlying reason why equating partial answerhood with relevance cannot explain the availability of non-resolving responses to polar questions.

We observe that a wide variety of non-resolving responses to polar questions turn out to be very natural in discourse. Examples (3-6) illustrate several dialogues in which a polar question $Q$ is responded to with a relevant but non-resolving answer. In our analysis, we will focus primarily on the semantic relation between these responses and the QUD. However, two tangentially related properties of these responses bear mentioning: the availability of ellipsis in the A2 answers, and the preference for the rise-fall-rise intonational contour (L*+H L-H%, Ward and Hirschberg, 1985) in each of these examples.

(3) Q: Is John going to Coachella?
   A1: He’s either going to Coachella or Lollapalooza.
   A2: Or Lollapalooza.

(4) Q: Should we cancel the picnic?
   A1: We should cancel if it rains.
   A2: If it rains.

(5) Q: Did Lucy win the race?
   A1: She might have won.
   A2: She might have.

(6) Q: Did Lucy come in first?
   A: She didn’t come in last.

First, let us discuss the various constructions that give rise to non-resolving responses to polar questions. Each example in (3-6) is weaker than some alternative in the QUD in an ordinary context. In (3), the response is a disjunction of one of the alternatives of the QUD with another proposition. In (4), an alternative is embedded in the consequent of a conditional, and as a result the QUD will only be resolved if the antecedent is determined to be true. In (5), an

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2 We provide examples in dialogue format in order to make the QUD unambiguous. However, in connection with implicit QUDs the facts regarding the (non-elliptical) responses should be identical.

3 As we will discuss in Section 4.3, this other proposition is generally not arbitrary; usually it is related to another QUD.
alternative is embedded under an epistemic possibility modal. Finally, in (6) the response is asymmetically entailed by one of the alternatives on the assumption there are more than two competitors in the race. In the literature on relevance, Hyska (2015) has discussed epistemic reports like (5), and Ginzburg (1995, 2012) has discussed both epistemic reports and conditional answers. To our knowledge, this work is the first to recognize the challenge posed by disjunctive answers (3) and answers like (6) that are entailed by some alternative.

1.1. Data discussion: the role of ellipsis and intonation

The availability of elliptical “short answers” to polar questions suggests that the answer is relevant to the immediately preceding question, rather than to some other possible QUD. This provides indirect evidence against an alternative analysis where non-resolving answers shift the current QUD. Jacobson (2016) has argued that short answers are felicitous only if they address an explicit QUD. For example, take (7) below, adapted from Jacobson (2016: e.g. 14). If it were possible to shift the QUD prior to the response (7A1), we would not expect the response to be infelicitous. For example, a possible shifted QUD could be Who left?, which carries no presupposition that the person who left is a mathematics professor. QUD shifting is only possible with a clausal answer (7A2).

(7) Q: Which mathematics professor left the party at midnight?
   A1: #Jill, but she’s not a mathematics professor.
   A2: Jill did, but she’s not a mathematics professor.

Our analysis (to be laid out in Section 3) does not require any manipulation of the QUD in order to explain the data in (3-6). This greatly simplifies the treatment of non-resolving responses, since any theory that relies on shifting the QUD has to either stipulate new QUDs, or provide a method to independently test for changes in the QUD, which is a difficult problem.

Furthermore, in each of these examples the rise-fall-rise contour (L*+H L-H%, Ward and Hirschberg, 1985) is preferred. This is unsurprising, as this contour has been argued to conventionally denote non-resolving answerhood (Wagner et al., 2013; though see Constant, 2012 and Westera, 2013 for slightly different theoretical perspectives), while a falling contour generally gives rise to exhaustivity inferences (Westera, 2017). This contour is especially crucial in understanding conditional answers like (4), which we do not intend to be interpreted with conditional perfection (Geis and Zwicky, 1971), i.e. pragmatically strengthened to a biconditional. Intonation can disambiguate between these two readings, with rise-fall-rise being consistent with the non-resolving interpretation of interest.

1.2. Roadmap

We have seen that the partial answer theory of relevance encounters systematic problems in accounting for polar question responses. The goal of this paper is to propose a different criterion for relevance that maintains the strengths of the partial answer theory, while making finer-grained distinctions between response types.

Under our proposal, a response to $Q$ can be relevant in one of two ways. It can be a partial answer to $Q$, or it can eliminate a partial answer from the common ground. An answer satisfying one of these conditions is called a reductive answer. Once the definition of relevance is up-
dated in this way, we show that the new data can easily be accommodated, and that the updated theory is not too permissive; it still rules out discourses that the original theory was designed to exclude. Moreover, the new theory is stated generally enough to make predictions about question types other than polar questions. In Section 2, we review the theories of relevance that our account builds on. In Section 3, we present the formal details of the analysis, and show how it works in a few concrete cases. In Section 4, we point out some desirable predictions of our proposal outside polar questions, and suggest some slight modifications of the account. In Section 5 we conclude.

2. Background

2.1. Defining Relevance

The importance of relevance to pragmatic theory can be traced back at least to Grice’s (1975), whose Maxim of Relation states that cooperative speakers should strive to make only relevant contributions to the discourse (or simply “Be relevant.”). Subsequently there have been several attempts to make Grice’s idea explicit and fully characterize the conditions under which a discourse move is relevant (Sperber and Wilson, 1986; Ginzburg, 1995, 2012; Roberts, 2012: inter alia). These accounts do not totally agree on two main points: (1) the intended scope of a theory of relevance and (2) the empirical criteria for relevance. We will discuss each of these points in turn. Ultimately we will follow Roberts (2012) in evaluating the relevance of a discourse move relative to a question.

First, “relevant” is a two-place relation (though Grice’s original maxim does not make this explicit), but there is disagreement over what objects are being related. Roberts (2012) and Ginzburg (2012) evaluate the relevance of discourse moves, or speech acts. As for the second argument in the relation, there is more variation across accounts. Sperber and Wilson (1986) evaluate relevance with respect to a context, i.e. a set of assumptions or beliefs. In some work, Ginzburg focuses on characterizing the set of relevant responses to a query (Ginzburg, 2010). Finally, Roberts (2012) evaluates relevance with respect to a question, namely the question under discussion or QUD. Crucially, the QUD need not be the semantic content of any overt query from earlier in the discourse, but it is a part of the discourse context. We adopt Roberts’s view that relevance holds between a discourse move (a speech act) and the QUD (a set of alternatives). For convenience, we will sometimes refer to the discourse move by its semantic content (i.e. a proposition or a question). Furthermore, for clarity we will generally evaluate the relevance of moves with respect to an overt QUD, i.e. direct responses to queries, though we intend for our claims to apply equally to implicit QUDs.

Second, we need some empirical test for determining whether a discourse move is relevant to a given question. One criterion is infelicity, which we take to be evidence for irrelevance. In this respect, the maxim of relation differs from Grice’s other maxims. For example, while it is uncooperative to withhold information or be needlessly verbose, it is not infelicitous. Thus, a felicitous move must generally be relevant to the QUD, with one notable class of exceptions: One can felicitously make metadiscursive moves such as assertions of ignorance (8A), queries about relevance (8B), or clarification requests (8C). We follow Roberts (2012) in considering

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4We are interested in modeling relevance only for information-seeking discourse, and so we restrict our attention to assertions and queries. Different speech acts may prove relevant in other kinds of discourses.
such responses irrelevant to A’s question, as they do not make progress towards resolving the QUD.\(^5\)

(8) Q: Who is Betsy bringing to the wedding?
   A: I don’t know.
   B: Why does it matter?
   C: Who’s Betsy?

In fact, Ginzburg (1995) suggests a test that distinguishes relevant moves from metadiscursive ones. He notes that question embedding predicates like about and concerning can only be truthfully applied to relevant answers, as judged by native English speakers. This test is illustrated in (9).

(9) Q: When is the train leaving? (adapted from Ginzburg, 1995: e.g. 98)
   a. Jill: At 2:58./In about an hour./In a short while.  
      Jill provided information about when the train is leaving.
   b. Jill: I haven’t got a clue./We should be informed of this soon./It doesn’t matter.
      Jill did not provide information about when the train is leaving.

Ginzburg uses this as a test for a notion he calls aboutness, which is closely related to Roberts’s notion of relevance. Ginzburg’s definition of aboutness does not reduce to exhaustive answerhood in the case of polar questions, which distinguishes his notion from Roberts’s relevance. However, the definition is not stated in a possible worlds semantics, making it difficult to integrate with standard dynamic semantics in the tradition of Stalnaker (1978) and Roberts (2012).

2.2. Technical Background

We adopt Stalnaker’s (1978) dynamic model of discourse in which the discourse context is a set of worlds called the context set. Following Groenendijk and Stokhof (1984), we take a question to denote a set of propositional alternatives that form a partition over the context set. Groenendijk and Stokhof first define an equivalence relation over the pairs of worlds where the question abstract has the same extension. We call this relation \( R_Q \) (10a). From this relation, there is guaranteed to be a unique partition of the context set (10b). We use the term question to refer to this partition, and interrogative to refer to a sentence whose denotation is a question.

\[
\text{(10) Definition: Question Denotation} \quad \text{If } Q \text{ is an interrogative with LF } wh_1,\ldots,wh_n(\beta), \text{ where } wh_i \text{ is the } i^{th} \text{ wh-word in } Q, D(wh_i) \text{ is the domain of } wh_i \text{ (e.g. } D(\text{who}) \text{ is the set of humans), and } \beta \text{ is the intension of an } n\text{-ary relation (} n \geq 0 \text{), in context set } c, \text{ then:}
\]

\[
a. \quad R_Q = \lambda w \lambda w' [\forall x_1 \in D(wh_1), \ldots, \forall x_n \in D(wh_n) [\beta^w(x_1, \ldots, x_n) \leftrightarrow \beta^{w'}(x_1, \ldots, x_n)]]
\]

\[
b. \quad [Q]^c = \{w \in c \mid R_Q(w, w') \} \mid w' \in c
\]

The question abstract \( \beta \) is the intension of an \( n\)-ary relation whose argument slots correspond to the \( wh \)-words in the question. When \( n = 0 \) (i.e. when \( \beta \) is a proposition), the resulting partition has at most two cells (a polar question).

In the partition view of questions, we can define several degrees of answerhood.

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\(^5\)Note that Ginzburg (2010, 2012) does apply the term “relevant” to metadiscursive moves. This may in fact be more faithful to Grice’s original intent, as such moves are arguably cooperative. See Hyska (2015) for discussion of ways to integrate moves of this kind into Roberts’s (2012) QUD framework.
Figure 1: Illustration of the dialogues in (12). The large box represents the context set, divisions correspond to cells in the QUD, and the gold region represents answers. ‘J’ labels the cells in which Jane ate the cookies, etc.

(11) a. **Definition: Resolving Answer**
Proposition \( a \) is a resolving answer to \( Q \) iff \( \exists q \in Q [a \subseteq q] \)
a entails an alternative in \( Q \).

b. **Definition: Partial Answer**
Proposition \( a \) is a partial answer to \( Q \) iff \( \exists q \in Q [a \cap q = \emptyset] \)
a eliminates (is inconsistent with) at least one alternative in \( Q \).

c. **Definition: Non-eliminating answer**
Proposition \( a \) is a non-eliminating answer to \( Q \) iff \( \forall q \in Q [a \cap q \neq \emptyset] \)
a eliminates no alternative in \( Q \).

In (12) below, A, B, and C are three possible responses to the question in \( Q \). These different response types are illustrated in Figure 1. A is a resolving answer because it entails exactly one of the alternatives in \( Q \). B is a partial answer because it eliminates several alternatives in \( Q \) (note that A is technically a partial answer for the same reason). C is a non-eliminating answer because it is consistent with every alternative in A.

(12) Q: Who (of Jane, Lucy, and Steve) ate the cookies?
A: (Only) Jane did.
B: Jane or Lucy, but not Steve.
C: # Jane ate the cake.

Quantified answers (13) are also partial answers. This is because the partition denoted by a *wh*-question is in one-to-one correspondence with the subsets of the *wh*-domain. Thus, any quantifier over that domain picks out a unique set of cells in the partition.

(13) Q: Who ate the cookies?
A: Every first grader.
B: Some second grader.
C: At most one teacher.

The definitions of resolving and partial answers are formulated to include **over answers**, i.e. answers that strictly entail a union of cells in the partition but are not equivalent to any particular union of cells. For example, in (14) the response in A eliminates all alternatives in which Jane did not eat the cookies. But it also eliminates worlds in the remaining cells in which Jane ate the cookies for breakfast.

(14) Q: Who ate the cookies?
A: Jane had them for lunch.

Roberts’s (2012) QUD theory provides the most influential formal account of relevance to date, as given in (15). Crucially, this definition is built around the notion of partial answerhood. We assume, as Farkas and Bruce (2010) do, that the goal of the conversational participants in information-seeking discourse is to empty the QUD stack. From this perspective, any partial answer makes progress towards this goal by eliminating alternatives from the current QUD. Empirically, this account makes many good predictions for *wh*-questions. For instance, the partial answers in in (12B) and (13) are all correctly predicted to be relevant, and the non-eliminating answer in (12C) is correctly predicted to be irrelevant.

(15) **Definition: Relevance (Roberts, 2012: to be revised)**

Move \( m \) is relevant to the QUD \( Q \) iff \( m \)’s content is (a) a proposition that is a partial answer to \( Q \), or (b) a question whose alternatives are partial answers to \( Q \).

The condition in (15) also applies to followup questions. If the QUD \( Q_1 \) cannot be resolved easily, one strategy to answer \( Q_1 \) is to ask an easier followup question \( Q_2 \) which, once resolved, is guaranteed to simplify \( Q_1 \). In Roberts’s account, the stereotypical and rational way to do so is to ensure that \( Q_2 \)’s alternatives are no stronger than \( Q_1 \)’s alternatives.\(^6\)

Sometimes, all the alternatives of the followup question \( Q_2 \) are weaker than the alternatives of \( Q_1 \). For instance, in (16), \( Q_1 \) is a pair-list question whose alternatives are those propositions that specify for each person what that person did and did not eat. On the other hand, the alternatives in \( Q_2 \) are all strictly weaker because they specify what Jane did and did not eat, but say nothing about other individuals.

(16) \( Q_1: \) Who ate what?
\( Q_2: \) What did Jane eat?

In other cases, \( Q_1 \) and \( Q_2 \) may share some alternatives. For example, in (17), the positive answer to \( Q_2 \) is one of the alternatives to A’s question (i.e. it is an exhaustive answer), while the negative answer is the union of the remaining alternatives.

(17) \( Q_1: \) Where did Sammy go?
\( Q_2: \) Did Sammy go to the store?

By contrast, (18) is an irrelevant followup question because knowing the time that Freddie is coming to dinner is not usually sufficient to eliminate any possibilities regarding what he is bringing.

(18) \( Q_1: \) What is Freddie bringing to the dinner?
\( Q_2: \) # What time is Freddie coming?

2.3. Problems

Despite some good predictions for *wh*-questions, Roberts’s (2012) theory is inadequate to account for relevance to polar questions. The problem stems from the fact that partial and re-

\(^6\) If \( Q_2 \) contains alternatives that are stronger than those in \( Q_1 \), then \( Q_2 \) may still be relevant to \( Q_1 \) according to (15) (recall that any resolving answer to \( Q_1 \) is also a partial answer to \( Q_1 \)). However, \( Q_2 \) cannot be considered part of a rational strategy to answer \( Q_1 \) if it turns out to be harder to answer.
solving answerhood are equivalent for polar questions by the definitions in (11). If \( Q \) is a polar question, it contains exactly two alternatives. If \( A \) is a partial answer to \( Q \), it eliminates at least one alternative. But this implies that \( A \) entails a single alternative to \( Q \), and is thus a resolving answer. Thus, any non-resolving answer to a polar question is predicted to be irrelevant under the Roberts (2012) theory. In light of clear counterexamples in (3)-(6), the theory clearly needs to be resolved.

Concretely, the partial-answer theory of relevance does not distinguish between dialogues like (19) and (20). In both cases, the response \( A \) is true at some worlds in the positive answer to the question \( Q \), and some worlds in the negative answer to \( Q \). Because \( A \) overlaps with both alternatives in \( Q \), \( A \) is predicted to be irrelevant to \( Q \).

(19) Q: Is John going to Coachella?
   A: He’s going to Coachella or Lollapalooza.

(20) Q: Is John going to Coachella?
   A: # Mary is going to Sinn und Bedeutung.

The next section refines the QUD theory of relevance to classify non-resolving responses like (19A) as relevant, but correctly rule out non-resolving responses like (20A). Once the analysis is adopted, we find that it makes desirable predictions in a wider set of cases. We will highlight the predictions about felicitous responses to \( wh \)-questions and followup questions in Section 4.

3. Analysis

The guiding intuition of our account is that felicitous non-resolving responses are not logically independent from the QUD alternatives. While learning that (19A) is true does not resolve the QUD (19Q), learning the negation of (19A) would in fact resolve the QUD. In other words, the question of (19A)’s truth is useful to the discourse because the information that (19A) is false would be sufficient to eliminate an alternative in the QUD. We argue that this observation holds true of all the relevant non-resolving responses to polar questions we have discussed. From the perspective that discourse participants are trying to find a strategy to empty the QUD stack, this observation is unsurprising. If resolving the question of whether \( a \) is true has the possibility to resolve the QUD, then asserting \( a \) ought to be considered part of a rational strategy to achieve this conversational goal.

If \( a \) meets this condition, defined formally in (21), then we call \( a \) a reductive answer. One can check whether \( a \) is a reductive answer by checking if either \( a \) or its contextual negation is a partial answer (22). Figure 2 illustrates how reductive answers compare to the other three answer types defined in (11). Clearly, if \( a \) is a partial (or resolving) answer, then \( a \) is a reductive answer. Furthermore, one can see in Figure 2(d) that a non-eliminating answer can be a reductive answer as long as its contextual negation (the white region) is a partial answer.

(21) **Definition: Reductive Answer**

Proposition \( a \) is a reductive answer to \( Q \) in context \( c \) iff \( \exists q \in Q \exists b \in \gamma a [c \land b \land q = \emptyset] \)

an alternative in \(?a\) is a partial answer to \( Q \)

(22) **Equivalent restatement of reductive answerhood**

Proposition \( a \) is a reductive answer to \( Q \) in context \( c \) iff either (a) or (b) holds:
We are now in a position to redefine relevance as in (23). We follow Roberts (2012) in saying that whether a response is relevant to the QUD depends on the logical relationship between the response and the alternatives in the QUD. However, we build our definition around reductive, rather than partial, answerhood. Thus, our definition is identical to Roberts’s (2012), but with partial answerhood replaced by reductive answerhood.

**Definition: Relevance (ours)**

Move $m$ is relevant to the QUD $Q$ iff $m$’s content is (a) a proposition that is a reductive answer to $Q$, or (b) a question whose alternatives are all reductive answers to $Q$.

The definitions in (21-23) form the core of our proposal. In what follows, we show how to capture the data in (3-6), and explore some other consequences of the account.

### 3.1. Accounting for the key data

In this section we show how the updated theory (23) predicts that the responses in (3-5) are in fact relevant, despite being non-eliminating answers according to (11). The examples are repeated below as (24-26).

(24) **Q:** Is John going to Coachella?  
**A:** He’s either going to Coachella or Lollapalooza.

(25) **Q:** Will we cancel the picnic?  
**A:** We’ll cancel if it rains.

(26) **Q:** Did Lucy win the race?  
**A:** She might have won.

In each case, the negation of the response A entails an alternative in the polar question Q. This is shown graphically in Figure 3. In each diagram in the figure, the negation of the answer (the white region) lies entirely within a single alternative in the QUD. For example, the worlds in the negation-set of (24A) are those worlds where John is going to neither Coachella nor Lollapalooza. In all such worlds, John is not going to Coachella. For (25A), the negation worlds...
are those where it rains and the picnic is not cancelled. Crucially, the picnic is cancelled in those worlds. Finally, the negation worlds for (26A) are the worlds where there is no possibility that Lucy won. In fact, those are all worlds where Lucy did not win.

Although our revised definition of relevance is strictly more inclusive than Roberts’s (2012), it still correctly excludes intuitively irrelevant responses like (27A). (27A) does not count as a reductive answer because neither (27A) nor its negation entails either the positive or negative resolution of (27Q).

(27) Q: Is John going to Coachella?
   A: # Mary is going to Sinn und Bedeutung.

3.2. Relevance is context-sensitive

Reductive answers, and by extension relevance, are defined in (21) in terms of their dynamic effect on the context set. Accordingly, we predict that whether or not an answer turns out to be relevant depends on the prior beliefs of the discourse participants. This kind of context sensitivity turns out to be necessary to capture certain types of relevant responses. For instance, in example (28) (repeated from (12C)), the response in A sounds deviant because it asserts a proposition that is logically independent from every alternative given by the QUD.

(28) Q: Who ate the cookies?
   A: # Jane ate the cake.

However, as (29) shows, it is easy to construct a context in which the same response is relevant. If it is common ground that Jane ate no more than one dessert, then this assumption plus the new information that Jane ate the cake jointly entail that Jane did not eat the cookies in the posterior context.

(29) Context: It’s mutually known that Jane is cutting calories and will only eat one dessert.
    Q: Who ate the cookies?
    A: Jane ate the cake.

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7Here we assume the conditional response has the truth conditions of the material conditional. In the Appendix, we discuss this example in a restrictor theory of conditionals following Kratzer (1981).

8This follows if \( \neg \circ p \) entails \( \neg p \). See the Appendix for more discussion in terms of Kratzer’s (1981) theory of modality.
Thus, the richer context in (29) ensures that A does contextually entail an alternative to the QUD, and is predicted to be relevant.

3.3. Informativity does not matter

A prediction of the account is that even answers with very little informative content can be considered relevant. This situation arises where the contextual negation of the answer has exceptionally low probability, as in (30). As Figure 4 shows, the answers in these examples overlap with almost the entire context set. This means that they provide very little new information. Nonetheless, we predict they are relevant because the eliminated worlds in the white region lie entirely inside one alternative.

(30) a. Context: It’s mutually known that John is in Boston or New York 99% of the time.  
Q: Is John in New York?  
A: Or Boston.

b. Child: Can I have a pony?  
Parent: If I win the lottery.

We consider this a good prediction. However, judging the relevance of these responses is difficult because assertions with low information content have low utility and may give the impression of being a rhetorical responses. For example, the parent’s response in (30b) may come off as a negative answer. Nonetheless, if we assume these are genuine answers, they are intuitively relevant.

3.4. Relation to previous work

It turns out that an answer is reductive (in our sense) just in case it is at-issue in the sense of Simons et al. (2010). Despite the resemblance between these two notions, our proposal differs from Simons et al.’s (2010) in several respects. First, Simons et al. do not change the definition of relevance for assertions, retaining essentially the theory from Roberts (2012). For Simons et al. (2010), not all at-issue responses are relevant, and the authors do not take a position on whether at-issue-ness determines the felicity of discourse moves. Second, Simons et al. are motivated by explaining projective content, while we take no position on whether reductive answerhood plays a role in projection.

Their footnote 3 briefly presages some of the problems for the QUD theory that we identify in this paper, but their proposal does not include an account of data like (3-6). Our goal in the
present work has been to clarify the scope of the problem for Roberts’s theory and explicitly relate our preferred solution to the data.

Others have proposed widening the class of relevant responses by defining relevance without reference to entailment. For example, Büring (2003) and Hyska (2015) suggest that a response can count as relevant as long as it shifts the probability weights of the alternatives in the QUD in a certain way. We find this approach appealing, and more work is needed to compare the predictions of the probabilistic theory to the entailment-based theory advanced here.

4. Further predictions

This section addresses consequences of our proposal beyond answers to polar questions. We find that our account succeeds in modeling *wh*-questions and followup questions. We also address cases of overgeneration by making other independently needed constraints explicit.

4.1. *Wh*-questions

Our proposal makes good predictions about responses to *wh*-questions, despite being formulated with polar questions in mind. Recall that partial answerhood as defined in (11b) is not trivial when applied to *wh*-questions: any disjunction of any number of resolving answers can be a partial answer, as long as at least one of the cells of partition is eliminated, as illustrated in (12B-C). However, some relevant answers do not fit this disjunctive pattern (31).

(31) Q: Who won the race?
   A: Lucy did, if Jane didn’t show up.
   B: Lucy might have.

First, a partial answer in the consequent of a conditional (31A), is correctly predicted to be relevant in our account, but not Roberts’s (2012). One can show that it is not a partial answer, because it is consistent with every cell in the partition. Indeed, if it does not rain, any cell in which Jane does not come can be eliminated, but if it does rain, any cell in the partition is still an epistemic possibility. By contrast, response A is a reductive answer because it eliminates from consideration any worlds in which it does not rain and Jane will not come to the party. More generally, embedding a partial answer in the consequent of a conditional does not preserve partial answerhood. However, it does preserve reductive answerhood. If *p* is a partial answer to *Q*, then *q → p* must be a reductive answer to *Q*, since its negation ¬*q ∧ p* is stronger than *p*.

Second, our account correctly predicts a partial answer under a possibility modal (31B) to be relevant. As in Section 3.1, we assume that *p ⊆ ♦p*. The answer in (31B) is not a partial answer, as it fails to eliminate any cells in the partition (any cell in which Jane does or does not come is still an epistemic possibility). However, its negation is a partial answer since ¬♦p is logically stronger than ¬p, making the answer itself a reductive answer. This reasoning applies in general to any partial answer under a possibility modal. For a more detailed and precise explanation, please see the Appendix (Section 6).
4.2. Followup questions

We find that the original QUD theory of relevance is too restrictive with followup questions—as with answers—when the QUD is a polar question. In Roberts’s (2012) definition of relevance (15), a question is considered relevant iff it is a subquestion as defined in (32).

(32) **Definition: Subquestion (paraphrased from Roberts, 2012: 6:15)**

\[ Q \text{ is a subquestion of } Q' \text{ if and only if every complete answer to } Q \text{ contextually entails a partial answer to } Q'. \]

We consider the follow-up questions in (33) to be relevant. However the negative answer to Q2 is consistent with both answers to Q1, and thus Q2 is not a subquestion according to (32).

(33) Q1: Does Sam have any pets?
Q2: Does she have a dog?

In fact, under definition (15), any polar question Q2 can only follow a polar Q1 if \( Q_1 = Q_2 \), assuming that both questions partition the same context set. The reasoning goes as follows: Q2 must be a subquestion of Q1, therefore both alternatives in Q2 must be a partial answer to Q1. However, the only partial answers to polar questions are resolving answers, so both alternatives in Q2 must be a subset of an alternative in Q1. The only way for this to be true is if Q2 and Q1 contain identical alternatives.

By contrast, our account allows for polar questions with non-trivial relevant followups. We extend the notion of a subquestion to the more inclusive category of **reductive question** in (34) simply by replacing partial answerhood with reductive answerhood. According to our definition of relevance, a question is relevant iff it is a reductive question of the current QUD (see (23b)). Q2 in (33) comes out as relevant on this account because the positive answer to Q2 is a resolving answer to Q1 (Sam’s having a dog entails her having a pet), while the negative answer is a reductive answer to Q1.

(34) **Definition: Reductive Question**

\[ Q \text{ is a reductive question of } Q' \text{ if and only if every cell in } Q \text{ contextually entails a reductive answer to } Q'. \]

However, this account interestingly predicts that for any two polar questions \( ?p \) and \( ?q \), \( ?p \) is a reductive question of \( ?q \) iff \( ?q \) is a reductive question of \( ?p \). All that is required for \( ?p \) to be a reductive question of \( ?q \) is that one of the alternatives to \( ?q \) entails one of the alternatives to \( ?p \). But this implies that \( ?q \) will also be a reductive question of \( ?p \). Hence, we predict that the ordering of the questions in (33) should be reversible. We judge this to be a good prediction, as example (35) shows, though notably we get the additional inference that B was biased towards a negative answer. We leave an explanation of this inference to future work.

---

9In the following examples, it is best to evaluate the felicity of followup questions in a multilogue setting, where the followup question is directed at a participant other than the original asker. The original asker has already indicated ignorance about the original question, hence it is not rational to address a followup to them.

10There are some theories such as Isaacs and Rawlins’s (2008) in which not all questions on the QUD stack partition the same context set. In particular conditional questions are represented as a partition on the set of worlds satisfying the antecedent of the conditional. While the predictions regarding conditional questions would have to be reevaluated in such an analysis, the predictions for (33) are unchanged.
Who went where?

Where did Jane go?  Where did Sally go?

Did Jane go to Lollapalooza?  Did Jane go to Coachella?  ...  ...

Figure 5: A subquestion tree, visualizing the evolution of the QUD stack over time.

(35)  A (to B): Does Sam have a dog?
B (to C): Does Sam have any pets?
C: No.
B: Yeah, I didn’t think so.

4.3. Additional constraints on relevance

In this section, we will show that considering QUDs other than the current QUD allows us to explain why some reductive answers are intuitively irrelevant. For example, consider (36), which is a variant of (3) with a different answer. In both dialogues, a question of the form \(?p\) is answered with a proposition of the form \(p \lor q\). According to our definition of relevance (23), \(p \lor q\) is relevant regardless of the \(q\). Clearly, this is incorrect for (36).

(36)  A: Did Jane go to Lollapalooza?
B: # Or there is life on Mars.

This issue is not actually unique to reductive answers. When relevance is defined in terms of partial answers, a similar problem arises with conjunctive over answers, as in (37). The answer \(p \land q\) is always relevant to the question \(?p\) because it entails the positive answer \(p\).

(37)  A: Did Jane go to Lollapalooza?
B: #Yes, and there’s life on Mars.

We suggest that the irrelevance of the answers (36) and (37) is not due to the logical relationship between the answer and the question, but rather to the structure of discourse. Namely, they are irrelevant because they are built from units of meaning that do not come from a question on the QUD stack, as defined in (38).

(38)  **Ordering of the QUD stack (modified from Roberts, 2012)**
   a.  \(Q_1 < Q_2\) iff \(Q_1\) was asked prior to \(Q_2\), and \(Q_1\) and \(Q_2\) are both unanswered and accepted QUDs.
   b.  If \(Q_1 < Q_2\) then \(Q_2\) must be a reductive question of \(Q_1\).\(^{11}\)

In case that \(Q_1 < Q_2\) we say that \(Q_1\) is a higher QUD. Generally, a higher question on the stack is more finely divided partition of the context set than the current question, as depicted in Figure 5. We use this notion to define a new constraint Stack Relevance, which responses must satisfy in addition to QUD Relevance (defined in (23)).

(39)  **Stack Relevance**: A felicitous assertion must provide an exact partial answer (a union

\(^{11}\)In Roberts’s original formulation, \(Q_2\) must be a subquestion of \(Q_1\).
Stack Relevance is independently needed no matter which version of QUD Relevance we adopt. If we adopt the original notion based on partial answers, Stack Relevance is still needed to rule out (37). If we adopt our proposal in (23), then Stack Relevance is also needed to rule out (36) as well. Thus, the problem we address in this section is not unique to our account. Nevertheless, we think it is worth solving, and Stack Relevance is a plausible solution.

With Stack Relevance in place, we are now in a position to explain why (36) is infelicitous while (40) is felicitous. The felicity of (40) depends on whether the QUD stack contains a higher QUD $Q'$ such that the response (40A) is an exact partial answer to $Q'$.

\begin{equation}
Q: \text{Is John going to Coachella?} \\
A: \text{He's either going to Coachella or Lollapalooza.}
\end{equation}

A good candidate for $Q'$ is the wh-question Where is John going?. If we assume that $Q'$ is this question, and that it satisfies all the conditions to be a higher QUD for (40Q), then (40A) provides an exact partial answer to $Q'$. In this situation, Stack Relevance is satisfied.

However, we also predict that there is a different possible discourse context in which (40) does not satisfy Stack Relevance. This is because without a richer description of the context, nothing ensures that Where is John going? is a higher QUD. For example, the asker might have heard about a terrorist plot at Coachella, in which case their immediate goal in asking (40Q) is to find out whether John will be safe. In this alternative context, the answer (40A) would not meet the conditions for Stack Relevance. The predictions of our account in this area are subtle, and we think more work is needed to understand the judgements.

5. Conclusion

The key claim of this paper is that data involving polar questions force us to distinguish carefully among responses that are not partial answers. Some of these non-resolving responses are intuitively irrelevant, and produce incoherent discourses, while others are perfectly natural. All of the natural non-resolving responses (reductive answers) update the context in a particular way, eliminating worlds that verify some but not all of the alternatives given by the QUD. The unnatural responses eliminate worlds from every alternative, or none.

Our theory shares with Roberts (2012) the idea that the logical structure of the QUD determines the set of felicitous next moves at any point in a discourse, though we differ on the exact logical relationship that is required. By eliminating worlds from only some alternatives, reductive answers respect the partition given by the QUD, even though they fail to eliminate any alternative completely. We show in this paper that reductive answerhood proves to be a useful generalization of partial answerhood. By updating the theory of relevance, our aim is to strengthen the empirical foundations of the QUD theory.

\footnote{Note that in order for stack relevance to be non-trivial, we must assume that the Big Question is not on the stack. In a context $c$, the Big Question is the partition in which each world in $c$ occupies its own cell. In other words, it is the question corresponding to “Which world is the actual world?”. Since any proposition can be made up as a union of cells in the Big Question, no response is ruled out by stack relevance if the Big Question is on the stack.}
6. Appendix: Truth Conditions of Modals and Conditionals

This appendix shows how the results proposed in this paper can be maintained within a more articulated theory of modals and conditionals. Throughout this section, we will consider several responses to a polar question \( Q \) whose alternatives are \( q \) and \( \neg q \). In each case, we will show that the response in question is a reductive answer. Recall the definition of a reductive answer, which we restate in a useful equivalent form in (41).

\[
\text{(41) Reductive answer} \quad \text{Proposition } p \text{ is a REDUCTIVE ANSWER to } Q \text{ in context } c \text{ iff } \exists q \in Q[[c \cap p \cap q = \emptyset] \lor [(c \setminus p) \cap q = \emptyset]].
\]

either \( p \)'s contextual meaning or \( p \)'s contextual negation is a partial answer to \( Q \)

In each case below, \( a \) will stand for the response to \( Q \) under consideration. For each response \( a \), we will show that \( c \setminus a \subseteq \neg q \).

6.1. Epistemic possibility responses

The main claim of this subsection is that \( \text{might } q \) is always a reductive answer to the polar question \( ? q \). We will adopt a Kratzerian theory where the flavor of a natural language modal expression is modeled as a set of constraints on the modal base of the expression (Kratzer, 1981). Let \( B \) be a modal base, a contextually-supplied function of type \( \langle s, \langle s, t \rangle \rangle \). We define possibility modals as follows:

\[
\text{(42) Possibility modals} \quad \text{\( \diamond_B q \) = } \lambda w. \exists w'. B(w)(w') \land q(w')
\]

For epistemic modals like \( \text{might} \), we assume that the modal base is realistic, meaning that \( B(w)(w) = 1 \) for any world \( w \).

\[
\text{(43) might-responses} \quad [\text{might } q] = \diamond_B(q) = \lambda w. \exists w'. B(w)(w') \land q(w') \quad \text{(where for all } w, B(w)(w) = 1)
\]

We can now prove the following:

\[
\text{(44) Suppose } a \text{ is a response to } ? q \text{ of the form } \text{might } q. \text{ Then } c \setminus a \subseteq \neg q, \text{ and therefore } a \text{ is a reductive answer to } ? q. \text{\( \uparrow \)}}
\]

\[
\text{Proof: If } a \text{ is as above, then every world } w \in c \setminus a \text{ satisfies the following formula:}
\]

\[
\neg \exists w'[B(w)(w') \land q(w')]
\]

In words, there are no worlds \( w' \) that are \( B \)-accessible from \( w \) where \( q(w') \) is true. But recall that \( B \) is a realistic modal base, so \( B(w)(w) = 1 \) (\( w \) is accessible from itself). It follows that \( q(w) \) is false, so \( \neg q(w) \) is true. Thus, \( c \setminus a \subseteq \neg q \).

6.2. Conditional antecedents

The theory we are considering is one in which conditional antecedents serve as restrictors of modal operators (Kratzer, 1981). First, we will define some useful notation. As before, \( B \) is a modal base, a contextually-supplied function of type \( \langle s, \langle s, t \rangle \rangle \). If \( p \) and \( q \) are propositions (type \( \langle s, t \rangle \)), then we define binary and unary necessity modal operators \( \square \) as follows.

\[\text{We use } p \text{ to refer to both the function of type } \langle s, t \rangle \text{ and the set of worlds } w \text{ satisfying } p(w)\]
Non-resolving responses to polar questions: A revision to the QUD theory of relevance

(45) Necessity modals
\[ \Box_B(p)(q) = \lambda w. \forall w'. [B(w)(w') \land p(w')] \rightarrow q(w') \]
\[ \Box_B q = \Box_B(\top)(q) \], where \( \top \) is the tautological proposition.

In words, \( \Box_B(p)(q) \) is true at a world \( w \) if and only if: for every world \( w' \) that is \( B \)-accessible from \( w \) and where \( p \) is true at \( w' \), \( q \) is also true at \( w' \). Simply put, \( q \) must be true at all accessible worlds that satisfy the restrictor \( p \).

(46) Whenever \( p \) entails \( p' \), \( \Box_B(p')(q) \) entails \( \Box_B(p)(q) \). In other words, \( \Box_B \) is downward-entailing in its first argument. Thus, \( \Box_B q = \Box_B(\top)(q) \] entails all formulas \( \Box_B(p)(q) \), for any \( p \).

According to the conditionals-as-restrictors framework, every conditional sentence has an implicit or explicit modal operator whose flavor is given by the context-sensitive modal base \( B \).

We will analyze our key dialogue (4), repeated as (47) below.

(47) Q: Should we cancel the picnic?
A: If it rains.

We assume that the response involves ellipsis, and its non-elliptical counterpart is (48) below.

(48) If it rains, we should cancel the picnic.

We further assume that the modal base in (48) must be the same as the modal base in the question. Assuming that \( \textit{rain} \) and \( \textit{cancel} \) are propositions, the positive alternative in the question (47) can be paraphrased in logic as (49a) and the response can be paraphrased as (49b).

(49) a. Q: \( \Box_B(\lambda w'. \textit{cancel}(w')) \)
\[ = \lambda w. \forall w'. B(w)(w') \rightarrow \textit{cancel}(w') \]

b. A: \( \Box_B(\lambda w'. \textit{rain}(w'))(\lambda w''. \textit{cancel}(w'')) \)
\[ = \lambda w. \forall w'. [B(w)(w') \land \textit{rain}(w'')] \rightarrow \textit{cancel}(w'') \]

The key claim is that (49b) is a reductive answer to (49a), though it is not a partial answer. We must show that the negation of (49b) is enough to answer the question negatively. That is, the negation of (49b) entails the negation of (49a). This result can be obtained by contraposition: the fact (46) above gives us that (49a) entails (49b), so \( \neg(49b) \) entails \( \neg(49a) \). More intuitively, consider the negation of (49b). (50) below shows that \( \neg(49b) \) entails that there is some \( B \)-accessible world \( w' \) where we do not cancel the picnic. This entailment contradicts (49a) above, and therefore entails the negative answer to the question.

(50) \[ \lambda w. \neg \forall w'. [B(w)(w') \land \textit{rain}(w')] \rightarrow \textit{cancel}(w') \]
\[ = \lambda w. \exists w'. B(w)(w') \land \textit{rain}(w') \land \neg \textit{cancel}(w') \]
\[ \Rightarrow \lambda w. \exists w'. B(w)(w') \land \neg \textit{cancel}(w') \]

References


Is there *any* licensing in non-DE contexts? An experimental study

Stavroula ALEXANDROPOULOU — Utrecht University
Lisa BYLININA — Leiden University
Rick NOUWEN — Utrecht University

Abstract. Why is weak NPI *any* sometimes, but not always, licensed in non-downward entailing environments? In this paper, we present a series of experiments, where we probe the role of context in licensing *any* in the scope of various quantifiers. We compare our results to predictions made by three theories of exceptional NPI licensing. We show that contextual reasoning plays a role in non-monotonic environments, but that it does not in the scope of upward entailing quantifiers. Surprisingly, our results also show individual differences between the non-monotonic environments created by different quantifiers.

Keywords: polarity, monotonicity, NPIs, quantification, numerals.

1. Introduction

There is a long tradition in the literature of claims that downward entailment is an important ingredient in accounting for the distribution of negative polarity items (NPIs) (Fauconnier, 1975; Ladusaw, 1979). An example like (1) is felicitous since the NPI *anything* is in an environment that is downward entailing (DE) (viz. the scope of *none of the boxes*). In contrast, (2) is infelicitous since *some of the boxes* does not create such an environment.

(1) None of the boxes contain *anything*.
(2) *Some of the boxes contain anything.*

There is consensus, however, that downward entailment is neither a sufficient nor a necessary condition for NPI licensing. Here, we focus on the latter. Following Linebarger (1987), it is widely acknowledged that not all occurrences of NPIs are occurrences in DE environments. Among the well-known exceptions are non-monotonic quantifiers like *exactly*, see example in (3).

(3) Exactly two of the boxes contain anything.

These kinds of licit occurrences of NPIs in non-DE environments are not general, however. Minimally different examples like (4) are judged less acceptable, for instance.

(4) ??Exactly 98 of the boxes contain anything.

Our focus in this paper is to come to a better understanding why weak NPIs like the kind exemplified by *any* and its kin (wNPIs) are licensed in some, but not all, non-DE environments. In particular, we focus on different proposals in the literature as to why cases like (3) exist. These

1We would like to thank Chris Barker, Mingya Liu, Stephanie Solt, and Yasu Sudo for their constructive feedback, as well as the audiences of XPrag 2019, SuB24, ESPP 2019, and of the workshop ‘Semantics in Athens III’.

2These proposals, as is our research, are restricted to *any*-style NPIs. This is because only this subclass of polarity sensitive expressions is licit in (some) non-DE environments. That is, (i), with the strong NPI in *years*, contrasts starkly with (3).

(i) *Exactly two of the boxes have been opened in years.*
theories share the idea that wNPIs are licit in a non-DE environment only under specific contextual circumstances. They differ in the properties of the relevant contextual circumstances, giving rise to different predictions.

We conducted two experiments that test these predictions. Our first experiment tests the acceptability of any in environments with different entailment properties. In our second experiment, we investigate to what extent readers of sentences containing wNPIs in non-DE environments make assumptions about the context.

The plan is as follows: We will first briefly introduce three accounts of sentences like (3) and extract testable predictions. We then present our experiments and end by discussing what theoretical conclusions we can draw from our results as well as by suggesting some ideas for further investigation.

2. Theoretical background

We will compare three main approaches to NPI licensing in non-DE environments.

Under one of these, cases like (3) are seen as exceptional in that they are not actual cases of NPI licensing. Giannakidou (2008) proposes that NPIs are only licensed in non-veridical environments, see (5) for the definition of a non-veridical environment (= the scope of a non-veridical operator).

\[
(\text{Non-})\text{-veridicality of propositional operators}
\]

A propositional operator \(O\) is veridical iff \(O(p)\) entails or presupposes that \(p\) is true in some individual’s epistemic model \(M_{E}(x)\); otherwise \(O\) is non-veridical.

Ignoring the epistemic model part, (5) says that the scope of an operator \(O\) is non-veridical if the truth of \(p\) does not follow from \(O(p)\). Beyond this theory of licensing, Giannakidou proposes the existence of a rescuing mechanism that accounts for licit occurrences of NPIs in veridical environments.

Quantifiers are not propositional operators, so it is not trivial to apply (5) to examples like (3) or (4). We assume that what matters for veridicality of quantifiers is the existence of a witness. For instance, ‘exactly \(n\) students’ is veridical for \(n > 0\) since ‘exactly \(n\) students passed the test’ entails that there were students that passed the test. Under this generalisation of (non)veridicality to non-propositional cases, anything in (3) is an example of an NPI occurrence in a veridical environment. As such, on Giannakidou’s theory, the NPI is not licensed, but rather rescued. In order for a wNPI to be rescued, there has to be some contextually available parallel sentence that would license the NPI. For the case of (3) this would for instance be a statement that the number of non-empty boxes was low:

\[
\text{(6)} \quad \text{Not many boxes had anything in them.}
\]

Not many creates a non-veridical environment, since (6), for example, is compatible with a situation where all boxes were empty. Rescuing is less likely for the sentence in (4) since it is harder to connect to a parallel sentence with a non-veridical environment like (6). Overall, the rescuing mechanism does not distinguish between non-monotone and upward-entailing environments in a systematic way.

Diametrically opposed to this theory is by Crnič (2014), where cases like (3) are analysed...
in terms of a proper licensing mechanism. Crnič argues that wNPIs such as any trigger scalar alternatives, roughly: anything ⊃ two things ⊃ three things etc. In terms of the alternatives that anything triggers, it is semantically identical to an indefinite with covert numeral one – its alternatives involve higher quantities.

Such weak scalar items can be licensed by a covert even: that is, wNPIs in non-monotone environments are associates of covert even. The silent even is a covert counterpart of the overt focus particle even – a clause-level propositional operator that requires its propositional argument, its prejacent, to be less likely than all the relevant focus alternatives to the constituent it is adjoined to (scalar presupposition; Karttunen and Peters, 1979; Wilkinson, 1996, and many others). The likelihood relation is provided by the context.

Here is a felicitous use of overt even in a context where “Syntactic Structures” is the least likely book to be read, out of some contextually relevant set of books (LF and interpretation in (7b) and (7c), respectively):

(7) a. John read even SYNTAX STRUCTURES.
   b. [evenE [John read [Syntactic Structures]F ]]
   c. \[\{(7a)\}\]^c is defined only if for all relevant q in \{that John read x: x is a book\}: that John read Syntactic Structures < q.
      If defined, \[\{(7a)\}\]^c = 1 iff John read Syntactic Structures in w.

(adapted from Crnič (2014))

In a similar way, the felicitous use of anything in (3) relies on the way probabilities are set up by the context. (3) is acceptable if it is less likely that exactly two boxes have one thing in them than that exactly two boxes have two things in them, and so on. As Crnič shows, this is the case whenever there is the conditional expectation that more boxes have something in them.

One example of probabilities that the context might contain that would license anything in (3) is in Figure 1 (see next page). If we are interested in two boxes and how many things they are expected to contain, 1 is the least likely alternative. With the number of boxes increasing, the relations between probabilities also change.

As such, Crnič (2014) can account for the contrast between (3) and (4) on intuitively similar grounds as does Giannakidou, even though the mechanism is somewhat different. (4) is bad according to Crnič because it makes it unlikely that the speaker considers the number of boxes that contain stuff low.

Finally, Barker (2018) proposes that wNPIs are scope licensed: they are items that signal they have narrow scope relative to some other operator. Barker argues that signalling narrow scope is only useful when the wide scope interpretation does not entail the narrow scope interpretation – that is, when it is not the case that the narrow scope interpretation is the less informative one.

One environment where the wide scope interpretation of an existential entails the narrow scope interpretation is the scope of every, see (8). The wide scope interpretation (a single book that is read by every woman) entails the narrow scope interpretation.

(8) Every woman read [a book].
    \( \forall > \exists \) entails \( \exists > \forall \)
Barker capitalizes on the parallel between such entailments and the lack of NPI licensing:

\[(9) \quad \ast \text{Every woman read [any book].}\]

The consequence of the scope licensing view is that wNPIs are licensed only in non-upward entailing contexts:

\[(10) \quad (\text{Barker, 2018})\]

An NPI is scope licensed in a context only if a wide scope existential binding a variable in the position of the NPI does not entail a narrow scope existential binding that position.

Barker further assumes that scope-licensing needs to be supplemented with contextual constraints. That is, for Barker (2018) scope licensing is a necessary yet not a sufficient constraint, but he does not commit to any specific set of such constraints.

Here are the predictions derived from these three proposals that we test in two experiments:

**Giannakidou (2008)** Licit use of a wNPI in a non-DE environment (i.e., *rescuing*) is in principle possible in any veridical environment. That is, *rescuing* occurs both in the scope of upward monotone and non-monotone operators, as long as there is suitable contextual pressure.

**Crnič (2014)** Licit use of a wNPI in a non-DE environment is only possible in the scope of non-monotone operators (because the semantic condition on *even*-licensing cannot be fulfilled in an upward entailing context), always subject to suitable contextual pressure.

**Barker (2018)** Licit use of a wNPI in a non-DE environment is only possible in the scope of non-monotone operators. There are no specific predictions with respect to the role of context.
In what follows, we present our experiments (Experiment 1 and Experiment 2) that aimed at testing the above predictions.

3. Experiments

Experiment 1 aimed to test to what extent wNPIs, as represented by any, are accepted in the scope of non-downward entailing quantifiers. Experiment 2 tests whether the occurrence of wNPIs in non-downward entailing environments is modulated by a contextually inferred expectation.

3.1. Experiment 1

Experiment 1 consisted of an acceptability judgement task, carried out in English.

3.1.1. Methods

Participants. We recruited 39 participants via Amazon Mechanical Turk and excluded one of them because their native language was other than English. The data of 32 native English participants were included in the subsequent analysis, as we removed the data of 6 participants who judged correctly fewer than 75% of the filler items. All participants received $1.40 for participation in the study.

Materials & procedure. We showed participants sentences like (11), where QUANT stands for one of the following quantifiers: at least n, at most n, exactly n and between n and m\(^3\) (conditions ATLEAST, ATMOST, EXACTLY, BETWEEN, respectively), and the sentence either contained a DP headed by the wNPI any or the corresponding bare plural (factor POL; conditions NPI and BARE, respectively). Hence, the experiment had a 4 × 2 design, that is, experimental items appeared in 8 conditions.

(11) QUANT products had (ANY)\(_{Pol}\) artificial sweeteners in them.

Is this an acceptable sentence of English?
(click on your answer)

- Yes
- No

We asked participants to indicate whether sentences like (11) were acceptable sentences of English by clicking on Yes or No. We tested 16 experimental items intermixed with 32 filler items, 16 of which were designed so as to evoke a NO response while the rest to evoke a YES response. Each participant saw all eight conditions and two experimental items per condition, as well as the same 32 fillers. The total of 48 items was randomly ordered for each participant.

Participants were first asked to give their consent to participate in the study. Those doing so proceeded to the instructions of the experiment and after that to the main part of the experiment.

\(^3\)Across the different items, the choices for \(n\) and \(m\) were always small numbers.
3.1.2. Predictions

Under the valid assumption that responses arising from pragmatic reasoning are less readily given than responses where no such reasoning is required (Bott and Noveck, 2004; Cummins and Katsos, 2010; Katsos and Bishop, 2011, a.o.), Giannakidou’s (2008) approach predicts a difference in acceptability between ATMOST (non-veridical) and the other QUANT conditions with any, which all include veridical environments. ATMOST is the only condition where the wNPI does not need rescuing by means of pragmatic reasoning, but is licensed by a proper grammatical mechanism (non-veridicality).

On the contrary, according to Crnič (2014), one expects an additional discrepancy in acceptability between ATLEAST on the one hand, and EXACTLY and BETWEEN conditions on the other hand. On this account, only non-upward entailing environments allow wNPI licensing by covert even, hence the upward-entailing ATLEAST condition is expected to receive low acceptance rates in the NPI condition – lower than any of the three corresponding non-upward entailing QUANT conditions.

Lastly, on Barker’s account too, wNPIs are licensed only in non-upward entailing contexts (scope licensing). Thus, any in the ATLEAST condition is predicted to receive very low acceptance rates as compared to the ATMOST condition. However, in the absence of further explication, the non-monotone QUANT conditions could go either way, depending on possible further (contextual) licensing conditions on top of scope licensing.

3.1.3. Results & discussion

The collected categorical data (after the removal of bad subjects) were analysed with binomial generalised mixed models (glmer) using the lme4 package (Bates et al., 2014) in R (R Core Team 2019). Figure 2 shows the proportion of YES responses per experimental condition.

We set ATMOST and BARE as the reference levels of the factors QUANT and POL, respectively. Via model comparison, the model including the interaction term turned out to have the best fit as compared to the model with main effects for QUANT and POL ($\chi^2(3) = 13.533, p < .01$). Our model also included intercept random effects for participants and items.

As indicated by the lower acceptance rates of the NPI condition in Figure 2, the addition of the wNPI any to the experimental sentences reduces their acceptability overall. Indeed, our statistical analysis specifically revealed that adding the wNPI any to the AT MOST items significantly reduces their acceptability ($SE = .687, z = -4.817, p < .0001$). This is quite surprising, as at most was taken to be a paradigmatic NPI-licensing environment and chosen for this reason as the baseline condition of QUANT. However, this finding seems to be in line with Sanford et al.’s (2007) finding that at most might not be that negative after all, who also demonstrated

\[^4\text{Here too, the licit occurrences of wNPIs in non-monotone environments are context-dependent to some extent. Satisfying the scalar presupposition associated with covert even in non-monotone environments is contextually modulated by a commonly shared expectation. Such contextual modulation does not apply in the case of downward entailing contexts (any DE context satisfies the probability requirement). Thus, wNPI any will be less acceptable in the non-monotone EXACTLY and BETWEEN conditions than in the downward entailing ATMOST condition – under the assumption that contextual reasoning is reflected in acceptability rates.}\]
Figure 2: Mean response proportions and SEs per condition in the acceptability judgement task.

that *at most* is actually less negative than the downward entailing quantifiers *none*, *not many*, *few*, and *less than n*. We come back to this in section 4.

The statistical analysis further showed that participants judged the difference in acceptability between BARE and NPI conditions to be significantly greater for ATLEAST and for BETWEEN than for ATMOST (respective interaction effects: NPI×ATLEAST: $SE = 1.074, z = -3.128, p < .01$; NPI×BETWEEN: $SE = 1.063, z = -2.712, p < .01$). However, this effect did not reach significance for EXACTLY (NPI×EXACTLY: $p = .102$). That is, the acceptability drop that the addition of NPI causes is larger for ATLEAST and for BETWEEN, but not for EXACTLY, as compared to ATMOST.

The above results suggest that there is a discrepancy among the three non-downward entailing quantifiers in terms of acceptability (in the presence) of the wNPI *any* in their scope as compared to *at most*. More specifically, it is the class of non-monotone quantifiers that seems not to behave in a homogeneous way in that respect. This is not expected according to Giannakidou’s and Crnić’s accounts, while it appears to be consistent with the variable predictions that Barker’s account derives as to the non-monotone quantifiers.

In the next section, we report on the results of Experiment 2, which aims to uncover whether contextual expectation plays a role in rendering the uses of wNPs in different non-downward entailing environments licit and acceptable.
3.2. Experiment 2

Experiment 2 too was an offline judgement task conducted in English.

3.2.1. Methods

Participants. 56 native speakers of English participated in this experiment administered on Amazon Mechanical Turk. We rejected the data of 17 of them who answered correctly fewer than 75% of the filler items considered for participant removal. Thus, in the final analysis we included the data of the remaining 39 participants. All participants received $1.60 for taking part in this experiment.

Materials & procedure. In this experiment, we presented participants with the same items as in Experiment 1, which were all preceded by the sentence I didn’t expect this, see (12). The design was exactly the same as in Experiment 1, i.e., QUANT: ATLEAST, ATMOST, EXACTLY, and BETWEEN, and Pol: NPI and BARE.

(12) I didn’t expect this, but QUANT products had (ANY)Pol artificial sweeteners in them.

What do you think the writer of the sentence expected?
(click on your answer)

• that more products had artificial sweeteners in them
• that fewer products had artificial sweeteners in them

Participants now had to decide what the writer of the sentence expected: that is, illustrating for (12), whether they expected more products to have artificial sweeteners (higher expectation: HIEXP) or fewer (lower expectation: LOEXP). Our 16 experimental items were interspersed with 32 fillers, 10 of which contained an explicit bias toward a higher expectation on the part of the writer (higher bias; see (13)), 10 of them created a lower-expectation bias (lower bias; see (14)) and the remaining 12 were unbiased, see (15).

(13) I didn’t expect this, but only 2 of the invited speakers of the conference were female.

(14) I didn’t expect this, but the parcel arrived after 10:30.

(15) I didn’t expect this, but 5 climbers reached the summit.

Like Experiment 1, each participant saw all eight conditions and two experimental items per condition, as well as the same 32 fillers. The total of 48 items was randomly ordered for each participant.

Lastly, the participants who gave their consent to participate in the study were presented with the instructions and, before they proceeded to the main part of the experiment, they were also given two practice items in order to familiarise themselves with the task.

3.2.2. Predictions

For Giannakidou (2008), contextual licensing (i.e., rescuing) is a general option, available in any veridical environment, that is, it can apply in both upward entailing and non-monotone en-
vironments. To illustrate for the item in (12), sentence (16) would be made contextually available via the rescuing mechanism, licensing indirectly the wNPI any in the ATLEAST (upward entailing) and in the two non-monotone QUANT conditions of (12), BETWEEN and EXACTLY, due to the presence of the non-veridical operator not.

(16) Not many products had artificial sweeteners in them.

Given that sentence (16) may imply a higher prior expectation on the part of the writer as to the number of products with artificial sweeteners (see Sanford et al., 2007 on not many), the NPI condition of all three veridical quantifiers (at least, between, exactly) is expected to receive more HiEXP responses than their corresponding bare condition, and particularly more than in the case of ATMOST. This is because the wNPI any in the ATMOST condition is already (grammatically) licensed by non-veridicality, hence no pragmatic reasoning (relating to a higher expectation) applies.

On Crnić’s account, wNPIs are properly licensed by covert even (only) in non-upward entailing contexts and specifically when its scalar presupposition is satisfied. That is, the ATMOST, BETWEEN, and EXACTLY version of (12) with any is felicitous if it is less likely that QUANT products had one artificial sweetener in them than that QUANT products had two artificial sweeteners, etc. (see footnote 5). Unlike downward entailing quantifiers, for non-monotone quantifiers this is the case whenever there is the conditional expectation that more products had some artificial sweetener in them. Given that, it is predicted that (higher) expectation plays a role only in non-monotone contexts and that the difference in HiEXP responses between the NPI and the BARE conditions will be greater for the two non-monotone QUANT conditions than for the ATMOST condition. Contextual expectation as discussed in this account will not play any role in the ATLEAST condition – in such contexts wNPIs are not licensed to begin with as the presupposition of covert even is unsatisfiable.

Finally, from Barker’s theory, it follows that upward entailing contexts cannot host wNPIs. In that sense, the predictions of his account are similar to Crnić’s account. However, since Barker takes scope licensing only to be a necessary condition, there could be variation in the extent to which scope-licensing quantifiers need contextual reasoning to allow the NPI. Hence, while contextual expectation is not predicted to play any role in the ATLEAST items with any, we cannot derive any specific predictions as to the relative proportion of HiEXP responses to the three non-upward entailing QUANT conditions with any.

3.2.3. Results & discussion

The collected and cleaned categorical data on the basis of the higher- and lower-bias filler items were analysed with mixed-effects logistic regression models, similarly to Experiment 1. Our analysis included again QUANT and POL as predictors, with ATMOST and BARE as the respective references levels, and had intercept random effects for participants and items. Figure 3 shows the proportion of HiEXP responses per experimental condition.

Including the interaction term to the model significantly improved the model fit compared to the model with simple main effects for QUANT and POL ($\chi^2(3) = 9.748, p < .05$).

Note that, as in experiment 1, the number in the QUANT conditions was always small.
As Figure 3 displays, HiEXP seems to play no role in the ATLEAST items, while the opposite appears to be the case for the ATMOST condition overall. In particular, the statistical analysis showed that the ATMOST condition received reliably more HiEXP response rates at the baseline level of the BARE POL condition compared to all three non-downward entailing QUANT conditions (ATLEAST: $SE = .451$, $z = 6.949$, $p < .0001$; BETWEEN: $SE = .446$, $z = 6.872$, $p < .0001$, and EXACTLY: $SE = .364$, $z = 4.359$, $p < .0001$). This reveals that the use of the quantifier at most is regulated by a contextually available (higher) expectation (i.e., of an amount that is more than the asserted one). Interestingly, this turns out to be the case regardless of the addition of the wNPI any (simple effect of NPI: $p = .977$) and, thus, is in line with the claim that the use of negative quantifiers signals that the speaker had expected a bigger amount than that asserted (Sanford et al., 2007, and references therein).

More importantly, our analysis further showed that the difference between BARE and NPI was significantly larger for BETWEEN than for ATMOST (interaction effect NPI×BETWEEN: $SE = .563$, $z = −2.891$, $p < .01$), but this effect was not significant for the other non-monotone QUANT condition (NPI×EXACTLY: $p = .328$) or the upward-entailing condition ATLEAST (NPI×ATLEAST: $p = .733$). Hence, of all three non-downward entailing quantifiers tested, the presence of a wNPI triggers contextual reasoning relating to a higher expectation only in the scope of between, resulting in a non-homogeneous behaviour of the class of non-monotone quantifiers, similar to that found in Experiment 1.

The above results are at odds with Giannakidou’s proposal, which would have us expect similar
interaction effects for the veridical quantifiers *at least* and *exactly* too. That is, we only observe a role of context in one non-monotone environment and not in an upward entailing one. The results are also at odds with Crnič’s predictions since in his theory it would be expected that all non-monotone quantifiers, including *exactly*, display an interaction effect similar to that of *between*. The results are in line with Barker’s theory, but only because this theory allows idiosyncratic conditions additional to scope licensing and could posit that *exactly* does not need contextual reasoning to license wNPIs, but *between* does.

4. General discussion

We studied the acceptability and the triggering of contextual reasoning of sentences containing four different quantifiers with and without a weak NPI in their scope. Surprisingly, the two non-monotonic quantifiers behave differently. The acceptability of a wNPI in the scope of *exactly* is comparable to that of a wNPI in the scope of *at most*. Similarly, as is the case for *at most*, the presence of a wNPI in the scope of *exactly* has limited impact on the extent to which contextual reasoning is triggered. In contrast, the acceptability of a wNPI in the scope of *between* is more comparable to what we observed for *at least*. Moreover, *between* was the only quantifier for which we observed a significant impact of the presence of a wNPI on contextual reasoning.

The fact that the non-monotone quantifiers as a whole do not perform in a uniform way goes against both Giannakidou’s and Crnič’s theories. On the other hand, it is in line with Barker’s proposal, though not in a particularly enlightening way. The theory in Barker (2018) leaves space for differences between different non-monotone quantifiers in terms of NPI licensing, non-vacuous scope marking being a necessary but not a sufficient condition for NPI licensing.

So why do we observe the above discrepancy between *between* and *exactly*? It could be, of course, that our experiments were simply not sensitive enough to pick up effects for *exactly* quantifiers, similar to those for *between*. A more sensitive method or perhaps changing from a binary response to a Likert scale could help clarify the status of *exactly*.

There is, however, also a very real option that our results are indicative of some fundamental interpretative difference between *exactly* and *between*. One possibility is that our relevant finding could have to do with the so-called ‘phantom’ *at least* readings that *between* quantifiers have been claimed to have.

According to Marty et al. (2015), sentences with *between* are ambiguous between an ‘exactly’ reading and an ‘at least’ reading. Say, (17), under the ‘exactly’ reading would be true if four students were late – and false if six (or any number higher than five) students were late. This reading is detectable intuitively and perceived as the only reading of (17). However, Marty et al. (2015) argue that (17) has one more reading, namely, an ‘at least’ reading, under which (17) is true if six students (or any other number of students higher than three) were late:

(17) Between three and five students were late.

This reading is argued to be ruled out on pragmatic grounds, and thus, according to Marty et al. (2015), *between*-sentences are never used to convey the ‘at least’ reading – therefore the term ‘phantom’ reading. Still, some theories predict that both readings of *between*-sentences are available and are generated by grammar. Marty et al. (2015) in fact show in a series of experiments that both an ‘exactly’ and an ‘at least’ reading are available with *between*-sentences.
Importantly, the availability of ‘at least’ readings sets *between* apart from *exactly*. As the ambiguity in question affects the monotonicity profile of *between*, one might expect this ambiguity to affect the NPI licensing properties of *between* as well. This effect would be in the direction of decreased acceptability of NPIs in the scope of *between* due to the interference of the *at least* reading of *between*—as well as of a more important role of contextual factors as means of disambiguation. This is exactly what we observe in our experiments.

One way to pin down the role of ‘phantom’ readings of *between* in our study would be to control for factors that give rise to such readings. In particular, these readings only arise in distributive, as opposed to collective, contexts. As an idea for further investigation, one could compare the NPI-licensing behaviour of *between* in distributive contexts to that in collective contexts.

As a final remark, another idea of a follow-up study would be to try out the same experiments with a different baseline. As noted in the previous section, on the assumption that the downward entailing quantifier *at most* creates a paradigmatic environment for NPI licensing, we took *at most* to be the baseline condition for QUANT in our two experiments. However, this turned out to receive unexpectedly low acceptance rates when *any* was present (58% ‘Yes’ in Experiment 1). This finding is in line with Sanford et al.’s (2007) finding that *at most* is not a very negative quantifier, while *less than* has been found to be considerably more negative. Based on this finding, in order to have a more accurate baseline quantifier condition, it would be instructive to replace the superlative quantifiers *at most* and *at least* in our experiments with the corresponding comparative quantifiers *less/fewer than* and *more than*.

**References**


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Abstract. Random choice indefinites convey, roughly, that an agent made an indiscriminate choice. There is however no consensus on the exact nature of the modality that random choice indefinites express (Alonso-Ovalle and Menéndez-Benito, 2018). This paper discusses new data from Chuj, an understudied Mayan language. In this language, random choice indefinites feature a morpheme (komon) that can appear either as a nominal or verbal modifier (Royer and Alonso-Ovalle, 2019). We show that the modal component of komon departs from previous proposals on the nature of random choice modality. Both in DPs and VPs, komon conveys information about the likelihood of the event described. The modal component of komon is nevertheless tied to its syntactic position. VP-komon conveys that the most expected worlds where the described event happens are no more expected than the most expected worlds where it does not. DP-komon conveys a similar modal component, but hardwires a comparison between the likelihood of the event described, which involves an individual in the extension of the NP, and that of alternative events determined by considering alternative individuals in the extension of the NP.

Keywords: Modality, random choice, indefinites, Mayan.

1. Introduction

While modality cuts across syntactic categories (Kratzer, 1981), most work within formal semantics has traditionally focused on the modal component of verbal auxiliaries. The focus has recently broadened beyond the verbal domain (Arregui et al., 2017), though, causing questions about the cross-categorial nature of modality to emerge, for example: (i) What modal flavors can DPs express? (ii) To what extent do they mirror those of VP modals? (iii) To what extent is the type of modal component tied to its syntactic position? In this paper, we bring new data on the expression of random choice modality with relevance to questions (i-iii). We focus on a type of modal flavor that can be expressed by indefinite DPs crosslinguistically: random choice modality. Random choice indefinites convey, roughly, that an agent made an indiscriminate choice (see Alonso-Ovalle and Menéndez-Benito 2015, 2018 and references therein).

The data that we discuss come from Chuj, an understudied Mayan language spoken by roughly 70,000 speakers in Guatemala and Mexico (Piedrasanta, 2009). Chuj provides a vantage point

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2All data, unless otherwise attributed, come from original fieldwork conducted with speakers of the Nentón and San Mateo Ixtatán variants of Chuj. Data were collected in Huehuetenango, Guatemala and Chiapas, Mexico, and with a consultant in Montreal, Canada.

for the study of questions (ii-iii) with respect to random choice modality. As we will see, random choice DPs in Chuj feature a morpheme (komon) that can also show up in the verbal domain, where it conveys a modal component, too. This invites a comparison between the modality expressed by komon in different environments. We will see that the modal component that komon expresses depends on its syntactic position: within the verbal domain, komon conveys a comparison between the likelihood of the event described and other alternative events. Within the DP, komon can also convey a likelihood meaning component, but this time the modal component hardwires a comparison between the described event, involving an individual in the extension of the NP, and a set of alternative events determined with the help of alternative individuals in the extension of the NP. With respect to question (i), we will see that the study of komon contributes to the debate about the kind of modality contributed by random choice expressions, as the modality that komon conveys departs from that of other such expressions discussed in previous literature. While showing differences with other random choice expressions, komon also shows some commonalities. Like other unrelated random choice expressions, komon has a scalar, non-modal use. This poses the question, which will remain unanswered here, about why the modal and non-modal meanings go together across languages.

The paper is organized as follows. Section 2 provides some background on the expression of random choice modality and situates Chuj in the landscape of random choice indefinites. Section 3 explores the use of komon within the verbal domain and Section 4 within the nominal domain. Section 5 concludes with a summary and a question for future research.

2. Background: Chuj in the landscape of random choice expressions

Random choice indefinites are modal indefinites. Consider the Spanish sentence in (1), which includes the random choice indefinite un NP cualquiera (Alonso-Ovalle and Menéndez-Benito, 2011, 2013, 2018).

(1) María compró un regalo cualquiera.
    María bought a gift CUALQUIERA
    ≈ ‘María bought a random gift.’

The sentence in (1) can convey (i) the existential claim that María bought a gift (like its counterpart with a standard indefinite), and (ii) the modal claim that she could have bought any other gift (its random choice component).

Several other indefinites that can convey a random choice component have been identified across languages. These include Italian uno qualsiasi and un qualunque (Chierchia, 2013), Romanian un oarecare (Fălaus, 2015, 2014), German irgendein (Kratzer and Shimoyama 2002; Buccola and Haida 2017), as seen in (2), and the Korean na indeterminates (Choi, 2007; Kim and Kaufmann, 2007; Choi and Romero, 2008a), as (3) illustrates.

(2) Hans hat irgendein Buch gekauft.
    Hans has IRGEND-INDF book bought

3 Abbreviations are as follows: A: ergative/possessive; AG: agentive suffix; CLF: noun classifier; CUALQUIERA: Spanish cualquiera; DEM: demonstrative; DIV: derived intransitive suffix; DTV: derived transitive suffix; INDF: indefinite; IRGEND: German irgendein-; KOMON: Chuj komon; IV: intransitive status suffix; PFV: perfective; TOP: topic. We use random and, later on, unexpectedly in the translations of sentences with komon. This is just a rough approximation. We are not assuming that komon and random or unexpectedly are equivalent.

(3) John-un amwu-khadu-na cip-ess-e.
John-TOP AMWU-card-OR take-PAST-DEC
≈ ‘John picked a random card.’ (Choi 2007)

There is no consensus in the literature about what kind of modality random choice modality is. Chierchia (2013) suggests, mostly in passing, that Italian uno qualsiasi and German irgendein are interpreted under the scope of a covert bouletic modal. Under this proposal, the sentence in (2) is predicted to convey that Hans’ desires did not favour any specific book.

Alonso-Ovalle and Menéndez-Benito (2018) propose that the modality that un NP cualquiera contributes is interpreted relative to the decision of the agent of the described event. Under this view, the sentence in (1) conveys that María decided to buy a book and that that decision did not favour any specific book. Unlike what the bouletic account predicts, this modal condition can be true in cases where the agent wanted to pick a particular book (as long as he did not decide to do so).

Buccola and Haida (2017) put forth the claim that the interpretation of irgendein involves a simplicity-based comparison of alternative possible actions. Under their proposal, the random choice interpretation of irgendein arises when this indefinite is interpreted under the scope of the adverb einfach (‘simply’), which they assume can be covert. The basic idea is that irgendein contributes two components: (i) the proposition that Hans bought a book in a set $D$, and (ii) for any $D'$ that is a subset of $D$, the alternative proposition that Hans bought a book in $D'$. Einfach, on its turn, conveys the modal component that any alternative action described by the alternative propositions that irgendein contributes (buying a book in any of the subset domains) would not have been simpler for Hans. This excludes situations where Hans wanted to take a particular book, given that picking a book from a subset of books containing the desired book would have been “simpler” for Hans than picking a book from the whole set of books, since he would have to discard less books in that case.

Finally, Choi (2007) and Choi and Romero (2008b) propose, in the spirit of von Fintel 2000, that random choice modality is counterfactual modality. Under their analysis, (3) conveys that John picked a card and that he would have also picked one if the set of actual cards had been different. This modal component is satisfied in cases where the agent did not care about the identity of the cards (also in other scenarios, see Alonso-Ovalle and Menéndez-Benito 2018).

The sample of items expressing random choice modality that have been studied in the previous literature remains modest, and our understanding of the attested variation is, correspondingly, limited. We focus here on the expression of random choice modality in Chuj for two reasons. The first is that Chuj is similar enough to other previously studied languages to allow for a direct comparison. The language features DPs that can convey random choice modality. For instance, example (4), with modifier komon within an indefinite DP, can convey (i) that Xun bought a book, and (ii) that he could have bought any book, like its Spanish counterpart in (1).

(4) Ix-s-man [dp jun komon libro ] waj Xun
PFV-A3-buy INDF KOMON book CLF Xun
≈ ‘Xun bought a random book.’
The parallel with other previously studied languages does not stop there. Just like its Spanish counterpart, the sentence in (4) can appropriately describe scenarios like (5), where the random choice modal component is false, but the individual satisfying the existential claim is not a remarkable one (Alonso-Ovalle and Menéndez-Benito, 2018):

(5) ‘Unremarkable’ scenario: Juan[Xun] went to the bookstore. He wanted to buy *The Unbearable Lightness of Being*, and did so. I don’t think this book is special in any way.

The second reason why Chuj is well suited to contribute to the study of random choice modality is that it is different enough from other languages for a comparison to be interesting. For instance, as (6) illustrates, the modifier *komon* can also be part of the verbal complex:

(6) Ix-s-*komon*-man-ej jun libro waj Xun.
    PFV-A3-KOMON-buy-DTV INDF gift CLF Xun
    ≈ ‘Xun randomly bought a book.’

When *komon* is VP internal, it can also convey random choice modality. The example in (6), for instance, could be used, like (4), to convey that the agent was indifferent with respect to the issue of which book to buy. This provides an opportunity to probe into the semantics of random choice modality and into the potential differences between DP and VP-level modality. Crucially, when *komon* surfaces internal to the VP, it can also convey a “likelihood” component, which becomes apparent in sentences without agents, as (7), with an unaccusative verb.

(7) Ix-*komon*-k’och ix Malin.
    PFV-KOMON-arrive CLF Malin
    ≈ ‘Malin randomly/unexpectedly arrived.’

In (7), *komon* signals that the event of Malin arriving was not expected. Since this meaning component is not discussed in previous studies of random choice expressions, we are left with the question of how this likelihood component relates to the expression of random choice modality. In analyzing *komon*, we will proceed as follows. Section 3 will focus on VP-internal *komon*. We will see that VP *komon* contributes information about the likelihood of the event described and point out that this meaning component is satisfied in random choice scenarios. Section 4 will then focus on DP internal *komon*. We will see that DP-*komon* can also convey a likelihood component, one that differs from that of VP-*komon* in that it hardwires a comparison between the likelihood of alternative events determined with respect to the individuals in the extension of the NP.

3. VP komon

3.1. Distribution and interpretation

Chuj is an ergative-absolutive, head-marking language. Fully inflected verbs exhibit the template in (8) below:

(8) TAM – Set B – Set A – ADV – ROOT – STATUS SUFFIX

Tense-aspect-mood (TAM) and agreement markers precede the verb root. Following the tradition in Mayan linguistics, we refer to absolutive morphemes as “Set B”, and to ergative morphemes as “Set A” (these are also used to cross-reference possessors). So-called “status
suffixes” follow verbal roots. These affixes encode information about verb class membership, such as transitivity and derivational status.\(^4\) A third class of morphemes can precede the root in the position indicated by the box in (8). In this position we find a limited set of adverbs, including modifiers like \(te\) ‘a lot/repeteadly’ or \(wach\) ‘more’ (see e.g. Vázquez Álvarez 2011 for similar stem-internal material in Ch’ol). This is also the position where \(komon\) shows up within the verbal complex, as (9) illustrates.

(9) \(\text{Ix-ko-} \underline{komon}\text{-man-}ej \ \text{jun} \ \text{libro.}\)  
\(\text{PFV-A1P-KOMON-buy-DTV INDF book}\)  
\(\approx \) ‘We randomly bought a book.’

In Section 2 we saw that when \(komon\) appears internal to the verb stem in a transitive sentence, it can describe scenarios where the agent made a random choice. At the same time, we saw that in cases with non-agentive predicates, verbal \(komon\) conveys that the described event was not expected. Our strategy to understand the meaning contribution of VP-\(komon\) will be to start by looking at its interpretation in cases where it does not appear to give rise to different interpretations, i.e. when it does not combine with transitive verbs.

In examples like (10), where it combines with an unergative verb, \(komon\) conveys that the described event was not expected: the sentence in (10) can felicitously describe the scenario in (11a), but not the scenario in (11b).

(10) \(\text{Ix-} \underline{komon}\text{-chanhal-}w-i \ \text{waj} \ \text{Xun.}\)  
\(\text{PFV-KOMON-dance-SUF-IV CLF Xun}\)  
\(\approx \) ‘Xun randomly/unexpectedly danced.’

(11) a. Xun is waiting for the bus with other people seriously. He starts dancing. ✓
    b. Xun is at a venue where everyone is expected to perform the same dance, and so Xun dances it. ✗

The same interpretation is observed when VP-\(komon\) modifies an unaccusative verb (as well as other non-volitional predicates): for instance, the sentence in (12), repeated from (7), can felicitously describe the scenario in (13a), where Malin’s arrival was not expected, but not the one in (13b), where it was.

(12) \(\text{Ix-} \underline{komon}\text{-k’och} \ \text{ix} \ \text{Malin.}\)  
\(\text{PFV-KOMON-arrive CLF Malin}\)  
\(\approx \) ‘Malin randomly/unexpectedly arrived.’

(13) a. Malin lives far away and she didn’t tell us she’d visit, but she just arrived. ✓
    b. Malin told me she’d come visit at 2:00pm. It’s 2:00pm and she just arrived. ✗

We also find this interpretation with predicates overtly marked as statives through the stative suffix \(-nak\). To illustrate: the sentence in (14) conveys that Xuwan was not expected to be asleep; it can felicitously describe the scenario in (15a), but not the one in (15b).

(14) \(\text{Komon} \ \text{way-nak} \ \text{uch} \ \text{Xuwan.}\)  
\(\text{KOMON sleep-STAT CLF Xuwan}\)

‘Xuwan was unexpectedly asleep.’

(15)  
a. 5 year-old Xuwan is usually very excited in the morning, but this morning she was asleep. ✓
b. 5 year-old Xuwan has been running around all day. ✗

These examples make two points. First, VP-\textit{komon} can convey that the described event was not expected, as anticipated above. Second, given examples like (12), its modal component does not presuppose the existence of an agent, against some of the analyses of random choice modality presented in section 2 (Chierchia, Alonso-Ovalle and Menéndez-Benito, Buccola and Haida), which establish a connection between random choice modality and agentivity.

We turn now to the interpretation of \textit{komon} in combination with transitive verbs, as in (16):

(16)  
\begin{align*}
\text{Ix-s-} & \text{komon-yam-ej jun regalo ix Malin.} \\
\text{PFV-A3-KOMON-grab-DTV INDF gift CLF Malin} \\
\approx & \text{‘Malin randomly/unexpectedly grabbed a gift.’}
\end{align*}

As was the case with intransitive and stative predicates, the presence of \textit{komon} in (16) can convey that the described event is not expected. For instance, (16) is judged felicitous in the scenario in (17), where Malin did not grab a gift at random, but the event of Malin grabbing a gift was not expected, because it was not her turn to choose.

(17)  
\textit{Unexpected event scenario.} Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. \textit{It’s not Malin’s turn to choose}, when she notices that one of the gifts is wrapped in blue, while the other three in red. Even though it’s not her turn, she runs to the blue gift and unwraps it. It’s the jackpot!

The sentence in (16) can also felicitously describe the scenario in (18) where Malin did grab a gift a random, but where her grabbing a gift was expected, because it was her turn to choose.

(18)  
\textit{Random choice scenario.} Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. \textit{It’s Malin’s turn to choose}. All of the gifts are wrapped the same, so \textit{Malin just picks one at random}. It’s the jackpot!

In the unexpected event scenario in (17), the event of Malin grabbing a gift is \textit{less} expected than any of the most expected events. Given the facts, the most expected events would not be events of grabbing a gift at all, but events where Malin waits for her turn. In the random choice scenario in (18), Malin was expected to grab a gift, but the grabbing of the actual gift that she grabbed was no more expected than the event of grabbing any of the other gifts that she could have grabbed. We therefore propose that what unifies the felicity conditions on VP-\textit{komon} is a modal component that conveys that, given the circumstances, the most expected worlds where the described event happens are no more expected than the most expected worlds where that event does not happen. Because this meaning component can also capture the attested interpretation with intransitives and statives, we build an analysis of VP-\textit{komon} along these lines in the next subsection.
3.2. Analysis

We start by making some background assumptions. We will assume that transitive and unaccusative verbs express relations between individuals, events, and worlds, as in (19):

\[(19)\quad \text{a. } \left[ \text{grab} \right] = \lambda x. \lambda e. \lambda w. \text{GRAB}_w(x)(e) \quad \text{b. } \left[ \text{arrive} \right] = \lambda x. \lambda e. \lambda w. \text{ARRIVE}_w(x)(e)\]

We further assume that agents get added via Event Identification (Kratzer, 1996) and that vPs express relations between eventualities and worlds:

\[(20)\quad \text{a. } \left[ vP \text{ Xun grab that book } \right] = \lambda w. \exists e. \left[ \text{GRAB}_w(B)(e) \land \text{AGENT}(e)(\text{XUN}) \right] \quad \text{b. } \left[ vP \text{ Xun sleep-STAT} \right] = \lambda w. \exists e. \left[ \text{SLEEP}_w(s) \land \text{HOLDER}(s)(X) \right] \]

For convenience, we ignore the contribution of temporal and aspectual markers and assume external existential closure of properties of eventualities:

\[(21)\quad \text{a. } \left[ \exists e. \left[ vP \text{ Xun grab that book } \right] \right] = \lambda w. \exists e. \left[ \text{GRAB}_w(B)(e) \land \text{AGENT}(e)(\text{XUN}) \right] \quad \text{b. } \left[ \exists e. \left[ vP \text{ Xun sleep-STAT} \right] \right] = \lambda w. \exists e. \left[ \text{SLEEP}_w(s) \land \text{HOLDER}(s)(X) \right] \]

With these assumptions in place, we treat VP-komon as a vP modifier that adds a modal condition to the event description that the vP denotes: that among the worlds that share the relevant circumstances with the actual world, the most expected ones where (a counterpart of) the described event happens are no more expected than the most expected worlds where (a counterpart of) the described event does not happen.

This modal condition is formalized in (22). We assume a Lewisian ontology (Lewis, 1968), where individuals and events are world-bound. HAPPEN$_w(e)$ is true if a counterpart of e (an event maximally similar to e) is part of w'. The possibilities that the modal component of VP-komon invokes are projected from the set of events described by the vP (Haccquard, 2006). $f_{\text{circ}(i,t)}$ is a variable ranging over functions mapping events to sets of worlds and $f$ is its value ($v(f)$, where $v$ is the variable assignment). $f$ provides a certain type of circumstantial modal base: it projects from e the set of worlds w' where a set of circumstances (true facts) around the preparatory stage of e are true. Max$_{\leq g(w)}$ takes a set of worlds and returns those worlds within the set that are ranked at the top of an ordering ($\leq g(w)$) that ranks worlds with respect to how close they get to what is the most natural course of events in the world of evaluation w (we assume that there are always worlds ranked higher than any others). $g$ is the stereotypical ordering source determining this ordering: g(w) is a set of propositions describing the most natural course of events in w. For any worlds w, w', w'', w' $>_{g(w)}$ w'' iff w' gets closer to what is expected given the normal course of events in w than w''. The ordering is defined with respect to g(w) in the standard way: w' $\geq g(w)$ w'' just in case \{p : w' $\in$ p & p $\in$ g(w)\} is a (possibly improper) superset of \{p : w'' $\in$ p & p $\in$ g(w)\} (Kratzer, 1991). In an abuse of terminology, we write ‘p $\geq_{g(w)}$ q’, where p, q are sets of possible worlds, to convey that any p-world is at least as close to what is expected given the normal course of events in w than any q-world.

\[(22)\quad \left[ \text{komon}_i P \ f_{\text{circ}(i,t)} \right]^v = \lambda R_{(i,t)} \cdot \lambda e. \lambda w. R_w(e) \land \text{Max}_{\leq g(w)} \left( \left\{ w' : \text{HAPPEN}_w(e) \right\} \cap f(e) \right) \]

modal condition
To improve readability, we will abbreviate the modal condition in (22) as in (23):

\[(23) \quad \text{komon}_v \psi \varphi \quad \lambda w. R_w(e) \land \neg f - \text{EXPECTED}_w(e)\]

This modal condition covers the basic cases with intransitives and statives where \textit{komon} conveys that the described event was not expected. To illustrate, consider (10) again, which, as seen above, can describe the scenario in (24).

(10) Ix-komon-chanhal-w-i waj Xun.
    PFV-KOMON-dance-SUF-IV CLF Xun
    \approx ‘Xun randomly/unexpectedly danced.’

(24) Xun is waiting for the bus with other people seriously. He starts dancing. ✓

The sentence in (10) has the LF in (25a), interpreted as in (25b): the sentence is predicted to be true in a world \(w\) if and only if (i) there is an event \(e\) of Xun dancing in \(w\) and (ii) the most expected worlds in \(w\) where the relevant circumstances at the preparatory stage of \(e\) hold and \(e\) happens are no more expected than the most expected worlds where those circumstances hold and \(e\) does not happen. Figure 1 represents the main properties of the world corresponding to the scenario in (24). In this case, \(f\) projects possibilities from Xun’s dancing event. There are two types of possibilities: those where that dancing does not happen (represented by the top box), and those where the dancing happens. The most expected worlds of the first type (represented by the shaded box within the top box) are worlds where Xun waits for the bus. The most expected worlds of the second type (represented by the shaded box within the bottom box) are of course worlds where Xun dances. The arrow indicates that the former type of world is more expected than the second. The modal component is true in the scenario in (24).

(25) a. LF: \(\exists e \left[ \text{komon}_v \psi \varphi \left[ v \psi \text{Xun danced} \right] \right]\)
    b. \(\left[ (25a) \right]'' = \lambda w. \exists e [\text{AGENT}(e)(XUN) \land \text{DANCE}_w(e) \land \neg f - \text{EXPECTED}_w(e)]\)

\[\begin{array}{c}
\text{w}_1: Xun waits for the bus}\\
\text{g(w_1)}\\
\text{f(e_1)}\\
\text{w_0: Xun dances (e_1)}\\
\text{w_0: Xun waits for the bus}\\
\text{e_1 DOES NOT HAPPEN} \\
\end{array}\]

\[\begin{array}{c}
\text{g(w_0)}\\
\text{w_1: Xun waits for the bus}\\
\text{f(e_1)}\\
\text{w_0: Xun dances}\\
\text{w_0: Xun dances}\\
\text{e_1 HAPPENS} \\
\end{array}\]

Figure 1: Context: Xun komon-danced

We now turn to transitive sentences such as (16), repeated below, for which the modal condition should be satisfied in both the unexpected event scenario in (17) and the random choice scenario in (18).

(16) Ix-s-komon-yam-ej jun regalo ix Malin.
    PFV-A3-KOMON-grab-DTV INDF gift CLF Malin
    \approx ‘Malin randomly/unexpectedly grabbed a gift.’

Random-choice modality: The view from Chuj (Mayan)
The sentence in (16) has the LF in (26a), which is interpreted as in (26b): (26a) is predicted to be true in a world \( w \) if and only if (i) there is an event \( e \) in \( w \) such that there is a gift \( x \) and \( e \) is an event of Malin grabbing \( x \), and (ii) given the relevant circumstances around the preparatory stage of \( e \), the most expected worlds in \( w \) where \( e \) happens are no more expected than the most expected worlds in \( w \) where \( e \) does not happen.

(26) a. LF: \( \exists e \exists x \text{[a gift]} \langle e, \langle i, \text{st} \rangle \rangle \lambda_1 \text{komon}_w \langle \text{Malin grabbed } t_1 \rangle \]

b. \( \llbracket (26a) \rrbracket^w = \lambda w. \exists e \exists x \left[ \text{GIFT}_w(x) \land \text{AGENT}_w(e)(M) \land \text{GRAB}_w(e)(x) \land \lnot \text{f-EXPECTED}_w(e) \right] \)

The modal condition in (26b) is satisfied in the unexpected event scenario in (17). The leftmost picture in Figure 2 represents the main properties of the type of world represented by the unexpected event scenario. In this scenario, the modal base \( (f(e_1)) \) contains worlds where it was not Malin’s turn to choose. The most expected worlds where Malin does not grab the gift that she grabbed (which we will call ‘gift1’) are worlds where no gift is grabbed at all, since it is not her turn to choose. Crucially, those worlds are more expected than the most expected worlds where Malin grabs gift1.

The modal condition is also true in the random choice scenario in (18). There, the modal base picks up worlds where it was Malin’s turn to choose. As represented in the rightmost picture in Figure 2, this time the most expected worlds where Malin does not grab the gift that she actually grabbed (‘gift1’) and the relevant circumstances obtain are worlds where Malin grabs a different gift, given that she was expected to grab a gift. In the scenario, those worlds are as likely to occur as worlds where Malin grabs the gift that she actually grabbed.

Let us now consider the scenario in (27), where the modal condition of VP-komon is not satisfied:

(27) Unremarkable scenario. Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. It’s Malin’s turn to choose, when she notices that one gift is wrapped in blue, while the other three in red. Malin grabs the blue gift. *It’s a cheap gift!*

The target sentence in (16) is correctly predicted to be false in this scenario, since, given the
circumstances (Malin wants to grab the jackpot and it is her turn), grabbing the gift wrapped in blue is more expected than not grabbing the gift in blue, as shown in Figure 3.

In sum, we treat VP-\textit{komon} as a (syntactically) low circumstantial modal that adds to the denotation of the $\nu P$ a modal condition. This modal condition, which hardwires a comparison of events with respect to a likelihood ranking, is predicted to come out as true in both the unexpected and random choice scenarios.

We will move now to consider the interpretation of \textit{komon} in the nominal domain. As anticipated, we will see that when \textit{komon} conveys a modal component, it minimally differs in requiring the comparison between the likelihood of alternative events to be determined with respect to the individuals in the extension of the NP.

### 4. Komon in the nominal domain

Chuj exhibits no case morphology on nominals. So-called noun classifiers are used as definite determiners, and \textit{jun} is used as the singular indefinite determiner (Buenrostro et al. 1989, García Pablo and Domingo Pascual 2007, Royer 2019), as (28) illustrates. The example in (29) shows that a limited set of adjectives appear immediately before nominals (Maxwell 1976; Coon 2018), and \textit{komon} can appear on either side of adjectives, always preceding the noun.

(28) $\text{Ix-y-il} \quad [\text{jun}\ tzi’] \quad [\text{winh} \; \text{winak}].$

\text{PFV-A3-see} \quad \text{INDF dog} \quad \text{CLF man}

‘The man saw a dog.’

(29) $\text{Ix-s-man} \quad [\text{DP} \; \text{jun} \; \{\text{komon}\} \; \text{saksak} \{\text{komon}\} \; \text{libro} \; \text{ix}].$

\text{PFV-A3-buy} \quad \text{INDF KOMON white KOMON book CLF}

$\approx$ ‘She bought a \{random\} white \{random\} book.’

### 4.1. Interpretation: NP-komon vs. DP-komon

Hopkins (2012) suggests that \textit{komon} grammaticalized from Spanish \textit{común} (‘common/average.’) In fact, when \textit{komon} appears in predicative position with no overt determiner, it conveys that the argument of the NP does not stand out compared to other individuals in the NP extension, as the paraphrase in (30) indicates.
This ‘unremarkable’ interpretation of NP-komon is also present with full DPs in object position. Example (31), for instance, can describe the unremarkable scenario in (27), repeated below:

(31) Ix-s-yam [DP jun komon regalo] ix Malin.
PVF-A3-grab INDF KOMON gift CLF Malin
≈ ‘Malin grabbed a random/average/unremarkable gift.’

(27) Unremarkable scenario: Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. It’s Malin’s turn to choose, when she notices that one gift is wrapped in blue, while the other three in red. Malin grabs the blue gift. It’s a cheap gift!

We will tentatively assume that, in cases like this, komon is a non-modal NP modifier that conveys information about where its argument stands in a contextually determined ranking of equivalence classes of individuals in the extension of the NP. This ‘NP-komon’ conveys that the argument of the NP is ranked around the middle of the contextually relevant scale, and that most individuals in the extension of the NP are in the same equivalence class as the argument of the NP. For instance, the sentence in (30) is naturally interpreted with respect to a ranking of sets of individuals that komon invokes can vary. For instance, in (32), the ranking seems to be grouping students with respect to the social status of their parents.

(32) Man komon estudyante-ok laj waj Xun, y-unin winh waj Justin Trudeau.
NEG KOMON student-IRR NEG CLF Xun, A3-child CLF CLF Justin Trudeau
‘Xun is not just any student, he’s Justin Trudeau’s son.’

In line with these observations, we note that NP-komon is deviant with nouns that describe entities that are hard to rank with respect to each other, or with singleton nouns, whose extension do not allow for non-trivial rankings, as shown in (33) and (34).

(33) ?Komon tumin jun k’en tik.
KOMON money one CLF DEM
‘This is average money.’

(34) # Ix-w-il k’en komon uj.
PVF-A1S-see CLF KOMON moon
‘I looked at the average moon.’

Nominal komon does not only convey an unremarkable interpretation, though. While komon can convey an unremarkable interpretation in the first sentence in (35), the second sentence, which can naturally follow the first, blocks this interpretation. With the continuation in (35), we see that DP-komon can contribute, like VP-komon, a likelihood component conveying that the event described—the appearance of the deer—was not expected.

(35) Ix-jaw [jun komon sakchej]. Te’ niwak nok’, te’-ay y-ib’ nok’. 
PVF-come INDF KOMON deer INTS big CLF INTS-EXT A3-strength CLF.
≈ ‘A deer unexpectedly appeared. It (the deer) was very big and strong.’
In object position, we can also see that DP-*komon* can convey more than the ‘unremarkable’ interpretation. The sentence in (31), where *komon* appears in the object of a transitive verb, is perceived as ambiguous in the random choice scenario provided in (18), repeated below. It can be taken to be false, under its unremarkable interpretation, since Malin grabbed an outstanding gift; but also true, under its random choice interpretation, because Malin grabbed a gift at random. This shows that a second interpretation, related to VP-*komon* and appropriate in scenario (18), is available.

(31) \[ \text{Ix-s-yam } [\text{DP jun } \text{id} \text{ komon regalo }] \text{ ix Malin.} \]
\[ \text{PFV-A3-grab INDF KOMON gift } \text{ CLF Malin} \]
\[ \approx \text{‘Malin grabbed a random gift.’} \]

(18) Random choice scenario: Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. It’s Malin’s turn to choose. All of the gifts are wrapped the same, so Malin just picks one at random. It’s the jackpot!

In sum, we saw in (35) that like VP-*komon*, DP-*komon* can convey a likelihood component. We also saw in (31) that DP-*komon* can describe the same random choice scenario as VP-*komon*. Since we saw in section 3.2 that both interpretations of VP-*komon* were tied to a likelihood component, we conclude that DP-*komon* can also convey a likelihood component.

Given these facts, we assume that there are two possible contributions of *komon* in the nominal domain. First, *komon* can contribute a non-modal ‘unremarkable’ interpretation, where it requires accessing a set of individuals (the NP extension). Second, *komon* can also convey that the event described is not likely; this contribution requires accessing the denotation of the vP, an argument of the DP. We therefore assume that these different contributions of *komon* in the nominal domain result from an ambiguity. *Komon* can be an NP modifier or a D modifier.

A piece of evidence in favour of this ambiguity comes from the following observation: when conveying random choice, *komon* does not tolerate any material intervening between the D and *komon*. For instance, the sentence in (36) is felicitous in the unremarkable scenario (27), but not in the random choice scenario (18).

(36) \[ \text{Ix-s-yam } [\text{DP jun } \text{id} \text{ komon regalo }] \text{ waj Xun.} \]
\[ \text{PFV-A3-grab INDF yellow KOMON gift } \text{ CLF Xun} \]
\[ \approx \text{‘Xun grabbed a yellow random gift.’} \]

In the rest of this paper, we only focus on the use of nominal *komon* as a D-modifier (DP-*komon*), and we leave the NP-modifier (NP-*komon*) use for future work.

4.2. DP-*komon*

A first attempt to capture the fact that both VP- and DP-*komon* have a modal component expressing unlikelihood would be to assume that DP-*komon* simply ‘plugs in’ the semantics of VP-*komon* onto the vP argument of the DP, as schematized in (37).

\[ \text{\begin{align*}
&[\text{jun } \text{id} \text{ komon } \text{id} \text{ (i,m)}] = \\
&\lambda P_{e, st} \cdot \lambda R_{e, (i, st)} \cdot \lambda w. \exists x [P_w(x) & \& [\text{id} \text{ komon}(i) \text{id} (R(x))] (e)(w)]
\end{align*}} \]

This would predict the right interpretation for DP-*komon* in subject position, as in (35) or (38).
below. The LF of (38), in (39a), is predicted to be true in the world of evaluation \( w \) if and only if there is an event \( e \) and a deer \( x \) in \( w \) such that \( e \) is an appearing of \( x \) and, given the circumstances around the preparatory stages of \( e \), the most expected worlds where \( e \) happens are no more expected than the most expected worlds where \( e \) does not happen. The sentence is predicted to be true in worlds where the appearance of the deer was not expected to happen.

(38) \( \text{Ix-jaw} \ [\text{jun komon sakchej}] \).

\[ \text{PFV-come INDF KOMON deer} \]

\( \approx \) ‘A deer unexpectedly appeared.’

(39) a. LF: \( \exists e \) a komon (f) deer \( \lambda \cdot \left[ t_1 \text{ appeared } \right] \)

b. \[ \llbracket (39a) \rrbracket = \lambda w. \exists e \exists x \left[ \text{DEER}_w(x) \land \text{APPEAR}_w(x)(e) \land \neg \text{f-EXPECTED}_w(e) \right] \]

Under this analysis, (31), with DP-komon in object position, also comes out true in the random choice scenario. The sentence has the LF in (40a), which is predicted to be true in a world \( w \) if and only if there is an event \( e \) and a gift \( x \) in \( w \) such that \( e \) is an event of Malin grabbing \( x \) and, given the circumstances around the preparatory stage of \( e \), the most expected worlds where \( e \) happens are no more expected than the most expected worlds where \( e \) does not happen. As we saw before, these truth-conditions are satisfied in the random choice scenario, where the most expected worlds where the event does not happen are still worlds where a gift is grabbed.

(31) \( \text{Ix-s-yam} \ [\text{dp jun komon regalo}] \text{ ix Malin.} \)

\[ \text{PFV-A3-grab INDF KOMON gift CLF Malin} \]

\( \approx \) ‘Malin grabbed a random gift.’

(40) a. LF: \( \exists e \) a komon gift \( \lambda \cdot \left[ t_1 \text{ grabbed } \right] \)

b. \[ \llbracket (40a) \rrbracket = \lambda w. \exists e \exists x \left[ \text{GIFT}_w(x) \land \text{AGENT}(e)(M) \land \text{GRAB}_w(e)(x) \right] \]

While these results are promising, the current analysis faces two challenges. The first is that it overgenerates. Under the current proposal, we expect DP-komon to be true, like VP-komon, in the unexpected event scenario in (17), repeated below.

(17) Unexpected event scenario. Malin is at a gift exchange. She knows there’s a jackpot of $1,000 and that the other gifts are cheap. There are four gifts left, one must be the jackpot. It’s not Malin’s turn to choose, when she notices that one of the gifts is wrapped in blue, while the other three in red. Even though it’s not her turn, she runs to the blue gift and unwraps it. It’s the jackpot!

This prediction is not borne out: (31) is judged false in (17). DP-komon seems to be blind to the fact that the actual grabbing—the fact that Malin grabbed a gift in the first place—was not expected. Rather, it requires that the actual grabbing be no more expected than the potential grabbings of any of the other gifts. This is not the case in the unexpected event scenario.

The second challenge is that the likelihood component is not available when the DP is headed by a definite determiner, as in (41), or by a universal determiner, as in (42). In these cases, only the unremarkable interpretation is perceived.\(^5\)

\(^5\)The examples in (41) and (42) were corroborated with proper context, not provided here for reasons of space.
(41) Ix-in-man \[\text{DP ch’anh komon libro.}\]
\[\text{PFV-A1S-buy CLF(=DEF) KOMON book}\]
\[\approx \text{‘I bought the average book.’}\]

(42) [Junjun komon libro ix-in-man-a’.
\[\forall \text{ KOMON book PFV-A1S-buy-TV}\]
\[\approx \text{‘I bought every average book.’}\]

In view of these challenges, we endorse a different analysis for DP-komon. Rather than comparing a particular event with the most expected worlds where this event does not happen (as VP-komon does), we propose that DP-komon hardwires a comparison of events that only differs with respect to the event participant that the DP ranges over. In (43), DP-komon takes as arguments a function from events to sets of worlds, and then a D and an NP to yield a DP denotation (a function from a relation $R$ between individuals, events, and worlds to a relation between events and worlds). This DP denotation does two things: first, it conveys what the DP without komon would have conveyed; this meaning component is marked as $\text{①}$ in (43). On top of that, a modal condition is added; it looks at all individuals in the NP extension that are not related to the described event $e$ by $R$ in the world of evaluation ($\text{②}$), and compares the likelihood of the event $e$ with the likelihood of other events $e’$ of the same type involving those individuals ($\text{③}$). The whole condition conveys that the most expected worlds where $e$ happens are no more expected than the most expected worlds where those alternative events $e’$ happen.$^6$

$$\text{③} \text{Max}_{\leq w’} \left( \{ w’ : \text{HAPPEN}_{w’}(e’) \} \cap f(e’) \right) \leq \text{Max}_{\leq w} \left( \{ w : \exists e’[R_{w’}(x)(e’)] \cap f(e) \} \right)$$

modal condition

Let us illustrate what these these truth-conditions predict for (31) in (18).

(31) Ix-s-yam \[\text{DP jun komon regalo} \text{ ix Malin.}\]
\[\text{PFV-A3-grab INDF KOMON gift CLF Malin}\]
\[\approx \text{‘Malin grabbed a random gift.’}\]

(18) Random choice scenario. Malin is at a gift exchange. She knows there’s a jackpot of $\text{1,000}$ and that the other gifts are cheap. There are four gifts left, one must be the jackpot. It’s Malin’s turn to choose. All of the gifts are wrapped the same, so Malin just picks one at random. It’s the jackpot!

The interpretation of the LF for (31), in (44a), is in (44b): the sentence is predicted to be true in a world $w$ if and only if (i) there is an event $e$ such that $e$ is a grabbing of a gift by Malin, and (ii) for every gift $x$ in $w$ that Malin did not grab, it holds that the most expected worlds in $w$ where $e$ happens (and the relevant circumstances obtain) are no more expected than the most expected worlds in $w$ where Malin grabs $x$.  

$^6$Under our analysis, DP-komon essentially creates a complex determiner, along the lines of (some of) the nonlocal modifiers discussed in Larson 1999, Zimmermann 2003, Schwarz 2006 and Morzycki 2016.
In the random choice scenario in (18), this modal condition is true. As illustrated in the leftmost diagram in Figure 4, none of the most expected worlds where Malin grabs an alternative gift are more expected than the most expected worlds where Malin grabs the gift that she actually grabbed. That is, since all the gifts are wrapped the same, she is as likely to grab the gift that she grabbed as any of the other gifts. Since Malin grabbed a gift in that scenario, the sentence is correctly predicted to be true.

The sentence in (31) is now correctly taken to be false in the unexpected event scenario, since, in this scenario, the grabbing of the blue gift was in fact more expected than any of the potential alternative grabbings, as represented in the rightmost diagram in Figure 4. 7

Finally, the current analysis gives us a possible way to account for the determiner restriction imposed on the likelihood interpretation of DP-`komon`. Consider (41), repeated below:

(41) Ix-in-man [DP `ch’anh komon libro ].

\[ e_1 \text{ DOES NOT HAPPEN} \]
\[ e_1 \text{ HAPPENS} \]

Figure 4: Random choice (left) and unexpected e (right) scenarios: Malin grabbed a komon gift

In (44), komon combines with a noun classifier, used as a definite determiner (Buenrostro et al., 1989; Royer, 2019). The classifier presupposes that there is only one book. DP-`komon` first asserts that the speaker grabbed that unique book. Then, DP-`komon` contributes the modal condition in (45). Given the uniqueness component of the definite, there will only be one individual

\[ \approx \text{‘I bought the average book.’} \]
that can satisfy the first conjunct in the antecedent of the conditional in (45). Since the speaker bought that book, the second conjunct in the antecedent of the conditional will fail to be true, and, so, the whole antecedent will be false. This means that the modal condition will hold vacuously and \textit{komon} will therefore contribute nothing more than what the DP without \textit{komon} would have contributed. To the extent that adding vacuous material can result in deviancy, we explain why only the unremarkable interpretation is perceived here.

\begin{equation}
(45) \forall y \left[ \left\{ \text{BOOK}_w(y) \land y \not\in \{ z : \text{BUY}_w(z)(e) \land \text{AG}(\text{SPEAKER})(e) \} \right\} \rightarrow \left( \max_{\leq g(w)} \left( \{ w' : \text{HAPPEN}_{w'}(e) \} \cap f(e) \right) \leq g(w) \right) \right]
\end{equation}

The same line of explanation can be extended to cases where \textit{komon} co-occurs with a universal quantifier, as in (42), repeated below. In this case, the non-modal component in the predicted truth-conditions will convey that the speaker grabbed all books. Therefore, much like with the previous case, the antecedent of the conditional in the modal condition will have to be false, since all books are in the set of things that the speaker grabbed, and, again, \textit{komon} would contribute nothing beyond what the DP without \textit{komon} would have contributed.

\begin{equation}
(42) \left[ \text{Junjun} \text{ komon} \text{ libro} \right] \text{ix-in-man-a’}.
\end{equation}

5. Conclusion

We started this paper with three questions: (i) What modal flavors can DPs express? (ii) To what extent do they mirror those of VP modals? (iii) To what extent is the modal component of modal expressions tied to its syntactic position?

With respect to question (i), we focused on random choice modality. We saw in section 2 that there is no consensus about the nature of random choice modality. Chuj presents a new case. In Chuj, random choice modality seems to derive from a modal component that conveys information about the likelihood of the type of event described. This meaning component is different from those discussed in previous proposals that tie random choice modality to agentivity (Chierchia 2013, Buccola and Haida 2017, Alonso-Ovalle and Menéndez-Benito 2018). With respect to question (ii), we found that the likelihood modal component associated with random choice modality can arise both at the vP and the DP levels, but, with respect to question (iii), we saw that the modal components expressed by VP- and DP-\textit{komon} were not exactly parallel: VP-\textit{komon} and DP-\textit{komon} differ in that the former conveys information about the likelihood of an event, while the latter compares the likelihood of an event with alternative events that differ with respect to its event participants.

One issue that we are leaving open for now is the precise characterization of the unremarkable interpretation, also possible when \textit{komon} arises as a nominal modifier. As discussed in the introduction, Spanish \textit{uno NP cualquiera} also has this interpretation (Alonso-Ovalle and Menéndez-Benito, 2018). Alonso-Ovalle and Menéndez-Benito (2018) assume that the random choice and unremarkable meanings of \textit{uno NP cualquiera} correspond to two different,
homophonous forms, but the fact that *komon* also has this interpretation poses interesting questions: Is there a reason why the unremarkable and random choice interpretations are lumped together across languages?

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Random-choice modality: The view from Chuj (Mayan)

Non-maximality and homogeneity: Parallels between collective predicates and absolute adjectives

Omri AMIRAZ — The Hebrew University of Jerusalem

Abstract. Sentences with definite plurals such as *The kids laughed* are known to display non-maximality and homogeneity. This is manifested not only in distributive predication but also in collective predication. However, I observe that collective predicates differ with respect to these properties: predicates like *gather* are non-maximal and homogeneous, while predicates like *fit in the trunk* are maximal and non-homogeneous. I argue that this distinction is parallel to a distinction in absolute gradable adjectives with totally-closed scales: *gather* patterns with adjectives like *open*, which have both maximum and minimum standard, while *fit in the trunk* patterns with adjectives like *full*, which only have a maximum standard. I account for the observed parallelism by analyzing collective predication using proportional scales.

Keywords: non-maximality, homogeneity, definite plurals, collective predicates, summative, integrative, *gather*/*numerous*, degree semantics, measure function, proportional scale.

1. Introduction

Sentences with definite plurals are known to display non-maximality and homogeneity. NON-MAXIMALITY means these sentences often allow for exceptions (Brisson, 2003). For instance, suppose that a teacher told a joke in class. Sentences (1a) and (1b) seem to have a similar meaning, but only (1a) can be used in a scenario where most, but not all, of the kids laughed.

(1) a. The kids laughed.
   b. All the kids laughed.

The term HOMOGENEITY has been used in the literature on plurals in different ways. I use it here to refer to cases where: (i) a sentence does not have complementary truth conditions with its negation; and (ii) the uncertainty regarding the truth value of the sentence is related to the proportion of the argument that satisfies the predicate (Löbner, 2000). For instance, suppose that when the teacher told the joke, half of the kids laughed, and the other half burst in tears.

Neither (2a) nor (2b) is judged as true in this scenario. Also note that while (2a) is similar in meaning to *All the kids laughed* in most contexts, its negation in (2b) is roughly equivalent to (2b-i) rather than (2b-ii).

(2) a. The kids laughed.
   b. The kids didn’t laugh.
      i. ≈ No kids laughed.
      ii. ̸≈ Not all of the kids laughed.

From this point on, I set aside the discussion of distributive predicates like *laugh* and focus on collective and singular predicates. Dowty (1987) observes that some collective predicates are very liberal in their non-maximality. For example, (3) is judged as true in a scenario where just a few of the kids actually built the raft, and the others sat idly and watched. This is known as a

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team credit interpretation.

Kříž (2016: 516-519) argues that some collective predicates are also homogeneous. In a scenario where half of the kids gathered in the schoolyard and the others gathered in the hall, neither (4a) nor (4b) is judged as true. Note, again, that (4b) is roughly equivalent to (4b-i) rather than (4b-ii).

(4)  a. The kids gathered in the schoolyard.
    b. The kids didn’t gather in the schoolyard.
       (i) \( \approx \) No kids gathered in the schoolyard.
       (ii) \( \not\approx \) Not all of the kids gathered in the schoolyard.

I observe that both non-maximality and homogeneity are correlated with the *gather/numerous* distinction proposed in Dowty (1987). The *gather* type consists of predicates that are compatible with proportional quantifiers like *all* and *most of* (5b). On the other hand, *numerous*-type predicates are incompatible with such quantifiers (6b). The generalization proposed here is that *numerous*-type predicates are always non-homogeneous, i.e., they have complementary truth conditions with their negations (disregarding the vagueness of predicates like *numerous*, which is related to degree rather than proportion). For instance, the *numerous*-type predicate *elect Mary for president* is non-homogeneous since either (7a) or (7b) has to be true. The notion of non-maximality is not applicable to *numerous*-type predicates because it is related to proportion, and these predicates hold of an argument as an integral whole (see Section 2.2).

(5)  a. The kids gathered in the schoolyard.
    b. \{All / most of\} the kids gathered in the schoolyard.
(6)  a. The kids were numerous.
    b. ?\{All / most of\} the kids were numerous.
(7)  a. The students elected Mary for president.
    b. The students didn’t elect Mary for president.

I further observe that collective predicates of the *gather* type differ in their non-maximality and homogeneity properties. As we have seen, the predicate *gather* is non-maximal and homogeneous (4). On the other hand, *fit in the trunk* (on its collective reading) is maximal and non-homogeneous. This predicate belongs to the *gather* type since it is compatible with proportional quantifiers (8). However, it is maximal since (9a) does not allow for exceptions—it is true only if all of the suitcases fit in the trunk. If at least one suitcase does not fit, then (9a) is false and its negation (9b) is true. This means that *fit in trunk* is non-homogeneous since the truth conditions of the opposing sentences are complementary. Also note that (9b) is equivalent to (9b-ii) rather than (9b-i), unlike the pattern that we have observed in the case of *gather* (4).

(8)  \{All / most of\} the suitcases fit in the trunk.
(9)  a. The suitcases fit in the trunk.
    b. The suitcases don’t fit in the trunk.
       (i) \( \not\approx \) No suitcases fit in the trunk.
       (ii) \( \approx \) Not all of the suitcases fit in the trunk.
Other predicates that pattern with *gather* include *look at each other, get along, scatter, and hold hands*. On the other hand, *be the same size* and *suffice for the guests* (with respect to its second argument) pattern with *fit in the trunk*. For example, (10a) can be judged as true even if some of the kids did not look at any other kids. In addition, (10b) is most naturally interpreted as (10b-i) rather than (10b-ii). In contrast, *be the same size* requires a maximal interpretation since one counterexample is enough to falsify (11a) and make its negation (11b) true.

(10)  
  a. The kids looked at each other.  
  b. The kids didn’t look at each other.  
    (i)  ≈ No kids looked at each other.  
    (ii) ̸≈ Not all of the kids looked at each other.  

(11)  
  a. The squares are the same size.  
  b. The squares aren’t the same size.  
    (i) ̸≈ No two squares are the same size.  
    (ii) ≈ Not all of the squares are the same size.  

These data support the view in Malamud (2012) and Križ and Spector (2017) that non-maximality and homogeneity are two sides of the same coin. Predicates like *gather* are non-maximal and homogeneous, whereas predicates like *fit in the trunk* are maximal and non-homogeneous. To the best of my knowledge, there are no predicates that are maximal and homogeneous or non-maximal and non-homogeneous. The question, then, is what makes a predicate belong to one category or the other.

(12)  
  The puzzle:  
  Why do *gather* and *fit in the trunk* pattern differently with respect to non-maximality and homogeneity?

This paper is structured as follows: in Section 2, I discuss non-maximality and homogeneity in singular predication. This discussion is important for two reasons: (i) it shows that the analysis needs to be general enough in order to apply both to collective and to singular predication; and (ii) I will use singular predication as the basic case since its semantics is less complex. Section 3 proposes an account for the puzzle in (12). I draw parallels between collective predicates like *gather* and *fit in the trunk* and absolute gradable adjectives with totally-closed scales like *open* and *full*, respectively. I argue that *gather* and *open*, which have both maximum and minimum standard, represent the general case, whereas *fit in the trunk* and *full*, which only have a maximum standard, behave differently due to their lexical semantics. Section 4 rejects an alternative analysis that treats this opposition as pragmatic rather than semantic. In Section 5, I briefly discuss the consequences of the proposed analysis for the distinction between gradable and non-gradable adjectives in terms of modification. Section 6 concludes.

2. Beyond plural predication

2.1. Non-maximality and homogeneity in singular predication

Löbner (2000) observes that non-maximality and homogeneity are not restricted to plural predication. A predicate like *be red* is non-maximal since (13a) can be judged as true even if some parts of the sofa are not red, e.g., the legs. *Be red* is also homogeneous because if half of the sofa is red and half of the sofa is green, neither (13a) nor (13b) is judged as true.

(13)  
  a. The sofa is red.  
  b. The sofa isn’t red.  
    (i) ̸≈ No parts of the sofa are red.  
    (ii) ≈ Not all parts of the sofa are red.
(13)  a. The sofa is red.
   b. The sofa isn’t red.
      (i)  ≈ No part of the sofa is red.
      (ii) ⊻ Not all of the sofa is red.

Corblin (2008) argues that the *gather/numerous* distinction is also not unique to plural (collective) predication. Some singular predicates are compatible with proportional quantifiers, just like *gather* (14), and other predicates pattern with *numerous* in being incompatible with such quantifiers (15).

(14)  a. Most of the kids gathered in the schoolyard.
   b. The sofa is entirely red.
   c. The dish is partly cold.

(15)  a. ?All of the kids were numerous.
   b. ?Most of the sofa is heavy.
   c. ?Fido partly barked.

I observe that while *be red* patterns with *gather* in being non-maximal and homogeneous (13), there are also predicates like *fit through the door, be gluten-free* and *be evenly warm*, which are maximal and non-homogeneous, just like *fit in the trunk*. Clearly, (16a) is true only if all of the sofa fits through the door; otherwise, (16b) is true. This means that whatever analysis we propose for the contrast we have observed in collective predicates should also account for the same contrast in the case of singular predicates.

(16)  a. The sofa fits through the door.
   b. The sofa doesn’t fit through the door.
      (i)  ⊻ No part of the sofa fits through the door.
      (ii)  ≈ Not all of the sofa fits through the door.

2.2. Summative vs. integrative predicates

Löbner (2000) proposes a binary classification of predicates based on inferences to parts:2

(17)  *Summative vs. integrative* (to be revised)
   a. A summative predicate is true of an argument only if it is true of every part in it.
   b. An integrative predicate is true of an argument as an integral whole.

For instance, *be red* is summative because *The sofa is red* is true just in the case that the parts of the sofa are red; *be heavy* is integrative because *The sofa is heavy* means that the sofa as a whole is heavy, not that its parts are heavy. Summative predicates are compatible with proportional quantifiers (14), but integrative predicates are not (15).

Classifying predicates based on inferences to parts is encumbered by certain difficulties (Landman, 2000: 164-173). For instance, (18a) allows inference to parts but is incompatible with proportional quantifiers (18b). In order to circumvent this problem, I will use the terminology in Löbner (2000) in a purely descriptive manner as an extension of the *gather/numerous* distinction (19).

\footnote{cf. Corblin (2008) for an alternative taxonomy.}
(18) a. The sofa weighs less than 100 kg.
b. The sofa partly weighs less than 100 kg.

(19) **Summative vs. integrative** (revised)
a. A summative predicate is one that is compatible with proportional quantifiers.
b. An integrative predicate is one that is incompatible with proportional quantifiers.

One would certainly like to explain the semantic basis of the distinction between summative and integrative predicates, and, indeed, several proposals have been made in the literature regarding the *gather/numerous* distinction, which is part of the broader issue (see e.g., Champollion, 2015; Kuhn, 2020). However, nothing in the analysis proposed in this paper hinges on that question, so I will remain agnostic on this point.

2.3. Interim summary

We have seen that both singular and collective predicates can be divided into two major categories: summative and integrative. Summative predicates can be further divided into two subcategories: (i) predicates that are non-maximal and homogeneous; and (ii) predicates that are maximal and non-homogeneous. The emergent taxonomy is summarized in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Summative</th>
<th>Integrative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Singular predicate</strong></td>
<td><em>be red</em></td>
<td><em>fit through the door</em></td>
</tr>
<tr>
<td><strong>Collective predicate</strong></td>
<td><em>gather</em></td>
<td><em>fit in the trunk</em></td>
</tr>
<tr>
<td><strong>Proportional modification</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Non-maximality</strong></td>
<td>non-maximal</td>
<td>maximal</td>
</tr>
<tr>
<td><strong>Homogeneity</strong></td>
<td>homogeneous</td>
<td>non-homog.</td>
</tr>
</tbody>
</table>

The goal of this paper is to account for the distinction between the two types of summative predicates and explain the non-maximality and homogeneity properties of each subcategory. In the next section, I will start with singular predicates and then return to collective predicates.

3. Analysis

This section is structured as follows: Section 3.1 presents the formal tools that will be used in the analysis: proportional measure functions and proportional scales, which were introduced in Solt (2018) for the purpose of analyzing proportional comparatives. Section 3.2 applies these tools to the positive form of summative predicates such as *be red* and *be wooden*. Section 3.3 discusses the question of what determines the standard of comparison for the positive form and argues that since proportional scales are totally closed by definition, summative predicates are similar to absolute gradable adjectives such as *open* and *full*. Section 3.4 discusses summative predicates that pattern with *open* in having both maximum and minimum standard. Section 3.5 discusses summative predicates that only have a maximum standard, just like *full*, and argues that their lexical semantics rules out a minimum standard interpretation. Section 3.6 summarizes the analysis.
3.1. Proportional measure functions

Sentences such as (20) are ambiguous between an absolute reading and a proportional reading. Probably, (20) is false under the absolute reading given that there are many more people living in New York City than in Ithaca, but it might be true under the proportional reading.

(20) More residents of Ithaca than New York City know their neighbors. (Solt, 2018)

a. Absolute reading: There are more people in Ithaca who know their neighbors than there are people in New York City who know their neighbors.

b. Proportional reading: The proportion of Ithaca residents who know their neighbors is higher than the proportion of New York City residents who know their neighbors.

Solt (2018) proposes that proportional readings of comparatives involve a proportional measure function, which maps parts of an entity to the proportion they represent of the totality. For instance, in the case of (20), the proportional measure function maps pluralities of Ithaca residents to the proportion they represent of the totality of Ithaca residents. A formal definition of a proportional measure function is given in (21), taken from Solt (2018: 1128).

(21) A PROPORTIONAL MEASURE FUNCTION is a function of the following form:

\[ \mu_{\text{DIM}^c}(y) = \frac{\mu_{\text{DIM}^c}(y)}{\mu_{\text{DIM}^c}(x)} \]

The proportional measure function is introduced by a null functional head Meas (for measure), whose denotation is given in (22). The symbol \( \oplus \) represents a generalized sum of the entities in the denotation of P. For example, \( \oplus \text{Ithaca-residents} \) is the sum of Ithaca residents.

(22) \[ [\text{Meas}_D]^c = \lambda x \lambda d \lambda y. [y \sqsubseteq x \land \mu_{\text{DIM}^c}^{\oplus P}(y) = d] \]

Solt (2018) focuses on plural distributive predicates, which are summative (Löbner, 2000), but her analysis can apply to summative predicates in general. For example, consider (23), which contains the summative (non-gradable) predicate be wooden. Its truth conditions can be derived in the same manner as (20), as shown in (24). Note that the dimension of the measure function is contextually determined. In distributive predication, the only possible dimension is cardinality, so (20) cannot be interpreted as “more residents as measured by weight”. On the other hand, the dimension of the measure function in (23) can be weight, area, volume, etc.

(23) More of the brown door is wooden than of the red door.

(24) \[ \max \left\{ d : \exists y [y \sqsubseteq \text{brown-door} \land \mu_{\text{DIM}^c}^{\oplus P \text{brown-door}}(y) = d \land \text{wooden}(y)] \right\} \succ \max \left\{ d : \exists y [y \sqsubseteq \text{red-door} \land \mu_{\text{DIM}^c}^{\oplus P \text{red-door}}(y) = d \land \text{wooden}(y)] \right\} \]

3.2. The positive form

The notion of proportional scales invites a comparison between summative predicates and gradable adjectives—the former involve proportional scales, and the latter involve ordinary degree
scales. This paper is concerned with the positive form of summative predicates like *be wooden* (26b). Just like we can ask how tall John has to be in order to qualify as tall in a given context (25b), we can also ask how much of the door has to be wooden for the door itself to be considered wooden (26b).

(25) Gradable adjective
   a. John is 6 feet tall. (measure phrase)
   b. John is tall. (positive form)

(26) Summative predicate
   a. This door is 80% wooden. (proportion phrase)
   b. This door is wooden. (positive form)

According to the standard analysis, gradable adjectives like *tall* are predicates of type \( \langle d, \langle e, t \rangle \rangle \) (Cresswell, 1976). They introduce a degree argument as part of their semantics, and this argument can be filled by a measure phrase (27a). In the absence of a measure phrase, a phonologically null *pos* operator fills this position (27b) and introduces a standard of comparison (Bartsch and Vennemann, 1972).

(27) a. John is \([\text{DegP} \text{ six feet} \ [\text{AP} \text{tall}]]\).
   b. John is \([\text{DegP pos} \ [\text{AP} \text{tall}]]\).

On the other hand, non-gradable adjectives like *wooden* are predicates of type \( \langle e, t \rangle \). The standard analysis of sentences like (26b) does not involve a *pos* operator since non-gradable adjectives do not lexicalize a degree argument. Rather, *wooden* combines with *this door* by Functional Application (FA). Nothing in the semantics says how much of the door is in fact wooden. However, since *wooden* is summative, it can also be associated with a proportion phrase (26a). In this case, the degree argument is introduced by *Meas* (28).

(28) This door is \([\text{MeasP} \text{ 80%} \text{Meas} \ [\text{AP} \text{wooden}]]\).

Solt (2018) suggests, following Schwarzschild (2006), that *Meas* is the covert instantiation of partitive *of*, e.g., in *Many of the students*. I will assume two types of *Meas*: one that modifies the DP (29a) and one that occurs inside the VP (29b). I will call the former *Meas_D* (determiner *Meas*) and the latter *Meas_A* (adverbial *Meas*). Adverbial quantifiers do not contain an overt partitive, so *Meas_A* does not seem to have an overt instantiation.

(29) a. 80% of this door is wooden.
   b. This door is 80% wooden.

Since *Meas_D* first combines with the DP and *Meas_A* first combines with the predicate, we need a slightly different denotation for *Meas_A* from the one we had for *Meas_D* in (22). The crucial difference between the two denotations is the order in which they take their arguments.

(30) \([\text{Meas_A}]^c = \lambda P(e) \lambda d \lambda x . \exists y [ y \subseteq x \land \mu_{\text{DIM- prop}}}^{\text{prop}}(x) (y) = d \land P(y)]\)

The semantic derivation of (28) is the following:

(31) \([\text{Meas_A wooden}]^c = ([\text{Meas_A}]^c)([\text{wooden}]^c)\)
    = (\lambda P(e) \lambda d \lambda x . \exists y [ y \subseteq x \land \mu_{\text{DIM- prop}}}^{\text{prop}}(x) (y) = d \land P(y)])(\lambda x . \text{wooden}(x))
    = \lambda d \lambda x . \exists y [ y \subseteq x \land \mu_{\text{DIM- prop}}}^{\text{prop}}(x) (y) = d \land \text{wooden}(y)] \) (by FA)
\[80\% \text{Meas}_A \text{wooden}\] = \((80\%)(\text{Meas}_A \text{wooden})\) (by FA)

One can view Meas merely as a type shifter that is needed for the proportion phrase to combine
with the summative predicate. In this case, Meas is not part of the structure in the absence of
a proportion phrase. I will take a different approach and assume that Meas is present whenever
the predication is summative. In the positive form—i.e., when there is no proportion phrase—a
null pos morpheme saturates the degree argument introduced by Meas, as in (32). This will
allow us to derive non-maximality and homogeneity.4

(32) This door is \([\text{Meas} \_\text{pos} \_\text{Meas} \_\text{AP} \_\text{wooden}]\).

There are two possibilities for the position of Meas in the positive form: as a sister of the DP
(Measp) or inside the VP (Measv). I choose the second option. The argument comes from the
way conjunction of a summative and an integrative predicate works. I assume that Meas cannot
combine with an integrative predicate like heavy:

(33) ?This door is \([\text{Meas} 80\% \_\text{Meas} \_\text{AP} \_\text{heavy}]\).

Now, one can conjoin a summative and an integrative predicate in the positive form (34a), but
not when there is a proportion phrase that attaches to a shared argument (34b). On the other
hand, the proportion phrase can attach to the summative predicate as long as its scope is limited
to the first conjunct (34c). I conclude that Measv is at play in the positive form.

(34) a. This door is wooden and heavy.
   b. ?80% of this door is wooden and heavy.
   c. This door is 80% wooden and heavy.

The same analysis applies to summative collective predicates (35b).

(35) a. The kids gathered in the schoolyard.
   b. The kids \([\text{Meas} \_\text{pos} \_\text{Meas} \_\text{VP} \_\text{gathered in the schoolyard}]\).

I follow Kuhn (2020), who argues that collective predicates like gather denote events which
can be divided into subevents that are also gathering events. Evidence for this comes from their
compatibility with same, which requires a plurality of events (Carlson, 1987). For example,
(36a) cannot describe a single event of Mary selling a book to John but requires two distinct
buying and selling events. According to Kuhn, the fact that (36b) is acceptable supports the
view that gather can be divided into a plurality of subevents.

4Bochnak (2013) proposes a similar analysis for sentences with an incremental theme argument such as Cathy ate
the apple. However, he assumes that the standard of comparison is always the maximum, which makes different
predictions compared to the analysis proposed in this paper.
5I remain agnostic regarding the mechanism that rules out a structure such as (33).
(36)  
  a. John bought and Mary sold the same book. (Barker, 2007)  
  b. For the first time in history, the main parties to the conflict have gathered in the same room.

3.3. The standard of comparison

We have yet to explain what determines the standard of comparison for being wooden or for having gathered. Summative predicates are associated with proportional scales, which are totally closed by definition. In this sense, summative predicates are similar to absolute gradable adjectives, which also have (partially or totally) closed scales. Kennedy (2007) argues that while the standard of comparison for relative adjectives like tall is relative to a comparison class, in absolute adjectives like dry the standard is relative to a scalar endpoint (cf., McNally, 2009; Toledo and Sassoon, 2011). For instance, (37b) does not mean that the towel is dry compared to other towels, but that it has a maximum standard of dryness. Kennedy ascribes this choice of standard to a principle of Interpretive Economy, articulated in (38), which favors a scalar-endpoint standard over a context-dependent, relative standard of comparison.

(37)  
  a. John is tall. (for a boy his age)  
  b. The towel is dry. (≈ completely dry)

(38)  
  Interpretive Economy (Kennedy, 2007)  
  Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions.

An absolute adjective can have a partially closed scale, in which case only one member of the antonym pair has a maximum standard (39a), or a totally-closed scale, in which case both antonyms have a maximum standard (39b).

(39)  
  a. The rod is perfectly {straight / ?bent}.  
  b. The glass is completely {full / empty}.

Kennedy (2007) distinguishes two types absolute adjectives with totally-closed scales: the open type and the full type. The open type has both maximum and minimum standard (40a), whereas the full type only has a maximum standard (40b).

(40)  
  a. The window is {completely / slightly} open.  
  b. The glass is {completely / ?slightly} full.

I argue that this distinction is parallel to the one we have observed for summative predicates. A predicate like be wooden has both maximum and minimum standard with respect to a proportional scale. It is easy to show that is has a maximum standard (41), but the minimum standard is trickier. English does not have a proportional modifier that is parallel to slightly, which is the diagnostic that is used in the literature for the existence of a minimum standard. However, Hebrew has such a proportional modifier. While bemikcat ‘slightly’ is a degree modifier (42a), it can be turned into a proportional modifier by attaching a clitic personal pronoun to it (42b),

6The similarity between plural predication and absolute adjectives has been suggested before in Burnett (2017: 151-155). Burnett compares sentences with definite plurals to maximum standard adjectives and argues that non-maximality is a case of imprecision. On the other hand, this paper argues that non-maximality is a result of having both maximum and minimum standard, so it is not an instance of imprecision. See Section 4 for discussion.
e.g., bemikcat-o (lit. ‘in its slightly’). Note that this adverb can also have a proportional reading when modifying a plural distributive predicate (42c).

(41) The door is \{completely / entirely / 100\%\} wooden.

(42) Modern Hebrew
a. ha-seret mafxid bemikcat.
   the-movie scary slightly
   ‘The movie is slightly scary.’
   (scariness scale)
b. ha-seret mafxid bemikcat-o.
   the-movie scary slightly-3SG.M
   ‘A small part of the movie is scary.’
   (proportional scale)
c. ha-srat-im mafxid-im bemikcat-am.
   the-movie-PL scary-PL slightly-3PL.M
   ‘A few of the movies are scary.’
   (proportional scale)

I observe that the open type and the full type interact differently with negation. In the open type, negation denies that the argument possesses a minimal degree. As a result, (43b) is similar in meaning to (43b-i). On the other hand, in the full type, negation denies that the argument possesses a maximal degree, so (44b) is similar in meaning to (44b-ii).

(43) a. The window is open.
   b. The window isn’t open.
      (i) \approx The window is closed.
      (ii) \not\approx The window isn’t completely open.

(44) a. The glass is full.
   b. The glass isn’t full.
      (i) \not\approx The glass is empty.
      (ii) \approx The glass isn’t completely full.

Note that the open type patterns with gather (4), repeated here as (45), while the full type patterns with fit in the trunk (9), repeated here as (46).

(45) a. The kids gathered in the schoolyard.
   b. The kids didn’t gather in the schoolyard.
      (i) \approx No kids gathered in the schoolyard.
      (ii) \not\approx Not all of the kids gathered in the schoolyard.

(46) a. The suitcases fit in the trunk.
   b. The suitcases don’t fit in the trunk.
      (i) \not\approx No suitcases fit in the trunk.
      (ii) \approx Not all of the suitcases fit in the trunk.

Following Kennedy (2007), I am assuming that the default for predicates with totally-closed scales is having both maximum and minimum standard, like open. Predicates like full, which only have a maximum standard, are the exception rather than the rule.
3.4. Summative predicates that are like the open type

Kennedy (2007) argues that out of context, open-type adjectives have a preference for a maximum standard interpretation in affirmative sentences (47a) and a minimum standard interpretation in negative sentences (47b). However, even in affirmative sentences, a minimum standard interpretation can be made salient by the context (47c). Kennedy ascribes these preferences to a Strongest Meaning Hypothesis (SMH) mechanism. Originally conceived for reciprocals, SMH states that stronger meanings are preferred, as long as they are consistent with world knowledge and the context (Dalrymple et al., 1998). In Upward-Entailing (UE) contexts, the maximum standard interpretation entails the minimum standard interpretation (47a). On the other hand, in Downward-Entailing (DE) contexts, the minimum standard interpretation is stronger (47b).

(47) a. The window is open. (maximum standard preferred)
   b. The window isn’t open. (minimum standard preferred)
   c. The window is almost closed, but not quite. It’s still open.

Interestingly, this is exactly the analysis that Krifka (1996) proposes for plural predication. Krifka (1996: 146) proposes that “[i]f a predicate P applies to a sum individual x, grammar does not fix whether the predication is universal \((\forall y[y \sqsubseteq x \rightarrow P(y)])\) or rather existential \((\exists y[y \sqsubseteq x \rightarrow P(y)])\), except if there is explicit information that enforces one or the other interpretation.” Given SMH, in UE contexts there is a preference for universal (=maximum standard) interpretation (48a), while in DE contexts there is a preference for existential (=minimum standard) interpretation (48b).

(48) a. The kids laughed. (maximum standard preferred)
   b. The kids didn’t laugh. (minimum standard preferred)

In Krifka (1996), plural distributive predication is stipulated to be underspecified between universal and existential quantification. I argue that we can ground this stipulation in scale structure. Summative predicates (e.g., plural distributive predicates) are associated with a proportional scale. Such scales are totally closed by definition, and by default, predicates with totally-closed scales can have both maximum and minimum standard. One may argue that we have just replaced one stipulation for another—i.e., Krifka’s stipulation of underspecification for Kennedy’s Interpretive Economy principle. However, I believe that unifying these two seemingly unrelated phenomena lends support to both of these analyses.

Summative predicates like be red pattern with the open type. This is demonstrated in (13), repeated here as (49). In (49a), the maximum standard is preferred, and we get the meaning that a maximal proportion of the sofa is red. In (49b), the minimum standard is preferred, so negation denies that a minimal (non-zero) proportion of the sofa is red. This results in homogeneity.

(49) a. The sofa is red. (maximum standard preferred)
   b. The sofa isn’t red. (minimum standard preferred)
      (i) \(\approx\) No part of the sofa is red.
      (ii) \(\not\approx\) Not all of the sofa is red.

Non-maximality is due to the possibility of choosing between maximum and minimum standard. Consider the following scenario: Bill is making mashed potatoes. His roommate, Sue,
notices that one of the potatoes has some green spots on it. Sue knows that green potatoes might be poisonous, so she utters (50a) to warn Bill. This sentence is felicitous even though only a small part of the potato skin is in fact green. Non-maximality is also possible under negation, but apparently more difficult to get. For instance, suppose that Bill is making a dish that calls for a bright red tomato. Sue hands him a tomato that has some green spots on it but is otherwise red. Then, Bill utters (50b). Again, this sentence is felicitous even though some, and possibly most, of the tomato is red.

(50) a. Don’t use this potato, it’s green. (minimum standard interpretation)
   b. I can’t use this tomato, it’s not red. (maximum standard interpretation)

These examples show that non-maximality can be rather extreme given the right context. This is also true for summative collective predicates like gather. The proposed analysis predicts that gather can have a minimum standard, where only a small subset of the plural entity denoted by the argument is actually involved in the gathering event. The following example has been suggested to me by Jeremy Kuhn (p.c.): In a Paris university, students protest by blocking the entrance to the elevator. There are 200 students involved in these protests, and they take turns in blocking the elevator. Marie, a professor at the university, walks into the building and sees five students in front of the elevator. Then, Marie says (51) to her colleague. In this scenario, gather allows for extreme non-maximality due to a team credit interpretation.

(51) The students are gathering in front of the elevator again. We’ll have to take the stairs.

3.5. Summative predicates that are like the full type

I argue that summative predicates that only have a maximum standard are the exception rather than the rule. They can be divided into two subcategories:

- evenly/equally/the same: universal quantification is built into their semantics
- fit/suffice: involve (indirect) comparison of degrees

Consider the contrast in (52). Adding evenly enforces a maximal interpretation—i.e., makes the minimum standard unavailable. As a result, evenly warm is non-homogeneous: either (53a) or (53b) has to be true since both sentences have a maximum standard interpretation.

(52) a. The room is warm, but it’s chilly by the window. (non-maximal)
   b. #The room is evenly warm, but it’s chilly by the window. (maximal)

(53) a. The room is evenly warm. (maximum standard)
   b. The room isn’t evenly warm. (maximum standard)

Such examples are instances of the internal reading of same, e.g., (54). Most analyses posit universal quantification as part of the semantics of same (e.g., Carlson, 1987; Dowty, 1985; Barker, 2007). Given that universal quantification is built into the semantics of predicates like be the same height, only the maximum standard is available, so the predicate is maximal and non-homogeneous.

(54) a. The boys are equally tall.
   b. The boys are the same height.
The other subcategory includes predicates like *fit*, with respect to its first argument, and *suffice*, with respect to its second argument. Both of these predicates are maximal and non-homogeneous (55)-(56).

(55)  
   a. The suitcases fit in the trunk. (false if one suitcase doesn’t fit)  
   b. The suitcases don’t fit in the trunk.  
      (i) ≈ No suitcases fit in the trunk.  
      (ii) ≈ Not all of the suitcases fit in the trunk.

(56)  
   a. The chairs sufficed for the guests. (false if one guest didn’t have a chair)  
   b. The chairs didn’t suffice for the guests.  
      (i) ≈ The chairs didn’t suffice for any of the guests.  
      (ii) ≈ The chairs didn’t suffice for all of the guests.

Note that *fit* and *suffice* are mirror images of each other in several ways. First, we have seen that the first argument of *fit* patterns with the second argument of *suffice*. Second, *fit* and *suffice* are integrative on their first and second arguments, respectively (57). Finally, as suggested to me by Ashwini Deo (p.c.), both predicates seem to involve an indirect comparison of degrees. They are mirror images also in this respect: (58a) conveys that the suitcases (taken together) are smaller in size than the trunk; (58b) conveys that there were more chairs than guests. Note that I am not suggesting that these are the truth conditions of these sentences. For instance, I take the truth conditions of (58a) to be that there is a root possibility of the suitcases being in the trunk. However, I suggest that we assess the truth or falsity of such statements by a comparison of some sort. This account also applies to absolute adjectives like *full* (58c).

(57)  
   a. ?The suitcases fit in most of the trunk.  
   b. ?Most of the chairs sufficed for the guests.

(58)  
   a. The suitcases fit in the trunk. [size(suitcases) ≤ size(trunk)]  
   b. The chairs sufficed for the guests. [number(chairs) ≥ number(guests)]  
   c. The glass is full. [volume(liquid) ≥ volume(glass)]

Given that the comparative meaning is not part of the basic meaning of these predicates, I cannot offer a compositional analysis. However, if one accepts that comparison is somehow involved in the evaluation of propositions with *fit* and *suffice*, we can explain why these predicates only have a maximum standard. According to von Stechow (1984), comparatives are interpreted using a maximality operator. Since size is additive, the maximal size of the sum of the suitcases is the size of all the suitcases taken together. Therefore, *fit in the trunk* requires a maximal interpretation.

3.6. Summary of this section

The analysis proposed in this section is summarized in Table 2.
Table 2: Partial taxonomy of predicates

<table>
<thead>
<tr>
<th></th>
<th>Summative / absolute gradable adjective</th>
<th>Integrative / non-gradable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard of comparison</td>
<td>Max + Min</td>
<td>Max</td>
</tr>
<tr>
<td>Scale introduced by Adj.</td>
<td>open</td>
<td>full</td>
</tr>
<tr>
<td>Scale introduced by Meas</td>
<td>be red</td>
<td>fit through the door</td>
</tr>
<tr>
<td>Scale introduced by Meas</td>
<td>gather</td>
<td>fit in the trunk</td>
</tr>
<tr>
<td>Degree/proportional mod.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Non-maximality</td>
<td>non-maximal</td>
<td>maximal</td>
</tr>
<tr>
<td>Homogeneity</td>
<td>homogeneous</td>
<td>non-homog.</td>
</tr>
</tbody>
</table>

Table 2 suggests a similarity between integrative predicates and non-gradable adjectives, which has not been discussed so far in this paper. Integrative predicates are non-scalar with respect to a proportional scale, just like non-gradable adjectives are non-scalar with respect to a degree scale. Note that these two properties are independent of each other: Integrative predicates can be gradable, e.g., *The door is very heavy*, and non-gradable adjectives can be summative, e.g., *Robocop is partly human*. Integrative predicates are incompatible with proportional modifiers (59a), and non-gradable adjectives are incompatible with degree modifiers (59b). Also, just like we cannot really talk about non-maximality with respect to integrative predicates, it makes no sense to say that loosely speaking, 7 is odd. Finally, non-gradable adjectives give rise to complementary truth conditions with their negations (60).

(59)  
   a. ?The door is entirely heavy.  
   b. ?7 is fully odd.

(60)  
   a. 7 is odd.  
   b. 7 is not odd.

4. Against a pragmatic account

In the previous section, I argued that the difference between predicates like *gather* and predicates like *fit in the trunk* is due to their lexical semantics. In this section, I reject an alternative analysis, which takes this distinction to be pragmatic. The idea goes as follows: *fit in the trunk* requires a maximal interpretation not because there is anything special about its semantics, but because it is difficult to come up with a context that would allow us to ignore exceptions in a sentence such as (61).

(61)  
   The suitcases fit in the trunk.

I have two objections to this analysis. First, it is unclear why out of the blue, a sentence like *The squares are the same size* strongly favors a maximal interpretation (11a), whereas *The kids looked at each other* does not (10a). Second, I argue that a semantic analysis better explains why certain predicates are more liberal than others in the proportion of exceptions they allow.

A consequence of the analysis proposed in this paper is that (contra Lasersohn, 1999) non-maximality is not a case of imprecision. Imprecision, also known as pragmatic slack or loose talk, is a pragmatic phenomenon that is relevant for expressions that have a fixed, precise se-
mantic meaning. For instance, (62) has a precise meaning, but in most contexts it can be used felicitously even if Mary arrived a few minutes before or after the said time.

(62) Mary arrived at three o’clock. (Lasersohn, 1999: 522)

Similarly, adjectives that have a fixed maximum standard allow for imprecision—e.g., (63a) can be used in certain contexts to describe a glass that is 95% full (Kennedy, 2007). On the other hand, it is not pragmatic slack to use (63b) to describe a partially open window. (63b) is perfectly compatible with the semantics of open since this adjective has both maximum and minimum standard. This is a difference not only of quality but also of degree—(63b) can be used even if the window is only 5% open (e.g., if the air conditioning is on), but (63a) can never be used to described a glass that is only 5% full.

(63)  
  a. The glass is full.
  b. The window is open.

I argue that the same holds for imprecision and non-maximality that are related to proportion. Summative predicates that are like the full type (see Section 3.5) can exhibit imprecision but not non-maximality since they have a fixed maximum standard. On the other hand, summative predicates that are like the open type (see Section 3.4) can exhibit non-maximality since they have both maximum and minimum standard. Just like in the domain of absolute gradable adjectives, non-maximality is more extreme than imprecision. For instance, shake hands has both maximum and minimum standard, so (64a) can be used in certain contexts even if, say, only six out of twenty-two players shook hands with other players. On the other hand, look at the same direction only has a maximum standard. (64b) might allow for imprecision in certain contexts, e.g., if one of the players is looking at the ground. However, it is definitely false if only six players looked at the same direction while the remaining sixteen looked at their feet.

(64)  
  a. After the game was over, the players shook hands.
  b. The players looked at the same direction in anticipation.

I conclude from these observations that there are good grounds to treat the distinction between the two types of summative predicates as semantic rather than as purely pragmatic.

5. Consequences for gradable vs. non-gradable opposition

According to the standard analysis, a non-gradable adjective like wooden cannot combine with degree modifiers like very because of type mismatch—wooden does not have a degree argument that very can combine with. Under the current analysis, once wooden combines with Meas, the resulting function has a type of \( \langle d, \langle e, t \rangle \rangle \), just like a gradable adjective. The question, then, is why sentences such as (65) are unacceptable.

(65)  
  a. ?This door is very wooden.
  b. ?This door is so wooden!
  c. ?This is the most wooden door that you will find.

I argue that these sentences are bad not due to type mismatch but due to a syntactic restriction on these modifiers. Some gradable adjectives are also summative, and one can stack a proportional modifier and a degree modifier in the same clause (66a). This is predicted since these modifiers occupy different structural positions (66b).
(66)  
a. The lagoon is partly very deep.
     b. The lagoon is $[Measp$ partly $Meas_A$ $[Degp$ very $[Ap$ deep$]]$.

Some adverbs are ambiguous between being a degree modifier and a proportional modifier, but others are restricted to one of these functions. For instance, (67) can mean that half of the area of the towel is dry, but it is also possible that all of the towel is somewhat damp. On the other hand, (68) is true only in the former scenario since Hebrew be-xelka ‘partly’ is only a proportional modifier. In contrast, the adverb very can only occur in a structural position below $Meas_A$ (66b).

(67) The towel is half dry.  
(68) Modern Hebrew
     ha-magevet yeveš-a  be-xelk-a.
     the-towel  dry-SG.F  in-part-3SG.F
     ‘The towel is partly dry.’

Comparatives pose another challenge for the proposed analysis. Non-gradable adjectives cannot occur in an ordinary comparative construction (69a). When a gradable adjective that is also summative occurs in this construction, only a degree reading is available. For example, (69b) cannot mean that a larger area of the red sofa is soft compared to the green sofa.

(69)  
a. ?The brown door is more wooden than the red door.
     b. The red sofa is softer than the green sofa. (only degree)

I suggest that this restriction is syntactic, just like the restriction on degree modifiers. Proportional comparatives in English are possible when more is attached to the argument, e.g., (23), repeated here as (70a) (see §3.1 for discussion). Bresnan (1973: 276) proposes that more is the comparative form of much and many. Note that much also must attach to the argument (70b)-(70c). It is conceivable that (69a) is bad for the same syntactic reason that (70c) is bad with much(ly). The prediction is that in languages that have an adverb like much(ly), comparatives like (69a) would also be acceptable. Unfortunately, I am not aware of such a language.

(70)  
a. More of the brown door is wooden than of the red door.
     b. {Most of/part of/80% of/much of} this door is wooden.
     c. This door is {mostly/partly/80%/much(ly)} wooden.

Note, however, that there are cases of proportional comparatives where more can attach to the predicate. This is possible when the comparison is not between individuals but within an individual. For example, (71a) means that in terms of area, a larger proportion of Vermilion Parish is water than land (compare with (71b)). Adverbial much(ly) cannot occur in this position (71c), and (71d) is used instead (compare with (71e)). I have no explanation for these facts.

(71)  
a. Vermilion Parish is more water than land.
     b. ?Snails are more water than humans (are).
     c. ?Vermilion Parish is much(ly) water.
     d. Much of Vermilion Parish is water.
     e. Vermilion Parish is mostly water.

Note that much is a Negative Polarity Item in some of its uses. However, the negative counterpart of (71c) is just as bad: ?Vermilion Parish isn’t much water. I thank the anonymous SuB24 editor for this comment.
6. Conclusion

The starting point of this paper was a distinction between two subtypes of collective predicates that belong to the *gather* type: predicates like *gather*, which are non-maximal and homogeneous, and predicates like *fit in the trunk*, which are maximal and non-homogeneous. I then observed that this distinction is not restricted to collective predicates but also found in summative singular predicates such as *be red* and *fit through the door*. I argued that summative predicates do not combine directly with their arguments—instead, they are mediated by a phonologically null functional head *Meas*, which introduces a proportional measure function.

Since proportional scales are totally closed by definition, summative predicates are similar to absolute gradable adjectives with totally-closed scales. Following Kennedy (2007), I assume that predicates with totally-closed scales have by default both maximum and minimum standard. This category includes summative predicates like *gather* (collective) and *be red* (singular) and absolute adjectives like *open*. On the other hand, some predicates with totally-closed scales only have a maximum standard due to their lexical semantics. This category includes summative predicates like *fit in the trunk* (collective) and *fit through the door* (singular) and absolute adjectives like *full*. The existence of a minimum standard is responsible for non-maximality and homogeneity—non-maximal interpretations arise when the context makes the minimum standard salient; homogeneity is a result of a preference for maximum standard in UE contexts and minimum standard in DE contexts.

Extending this analysis to distributive predication is left for future research. The main open question is how *Meas* interacts compositionally with the covert distributivity operator proposed in Link (1991). However, two points can already be made. First, plural distributive predicates are summative by definition (Löbner, 2000). Second, as far as I can tell, distributive predicates are always non-maximal and homogeneous—i.e., have both maximum and minimum standard. For instance, *These suitcases don’t fit in the overhead compartment* is homogeneous in its distributive reading since it conveys that none of the suitcases fit in the overhead compartment. In other words, the distinction that was observed in collective and singular predication is apparently not found in distributive predication. If this is true, an account of these facts will need to explain why the lexical semantics of a predicate like *fit* does not affect the availability of a minimum standard in distributive predication.

References


Exclamatory *As If*s
Justin BLEDIN — Johns Hopkins University
Sadhwi SRINIVAS — Johns Hopkins University

Abstract. In this paper, we investigate the meaning of exclamatory *as if* utterances. One of the main interpretive challenges raised by these constructions is to explain how they function to express incredulous denial of the *as if* complement despite the absence of any overt negating element. After rejecting a negation ellipsis account that assimilates exclamatory *as if*s to plain negative assertions, we develop an exclamation-based analysis that integrates Grosz’s (2011) “EX-Op” account of optatives and polar exclamatives with our earlier hypothetical comparative semantics for descriptive uses of *as if* in Bledin and Srinivas (2019).

Keywords: Hypothetical comparatives, exclamations, expressives, denial, topic situations

1. Introduction

This is the second installment of a larger project that aims to develop a cross-categorical account of *as if* constructions in English. In last year’s proceedings of *Sinn und Bedeutung* (Bledin and Srinivas, 2019), we focused on multiclausal “manner uses” such as (1) and on “perceptual resemblance reports” such as (2):

(1) Pedro danced as if he was possessed by demons.
(2) It smells as if there’s peach cobbler in the oven.

In this year’s SuB proceedings, we turn to root independent *as if*-phrases used by speakers to incredulously deny a salient expectation in the discourse context, which we call “exclamatory *as if*s” (Camp and Hawthorne’s 2008 “sarcastic *as if*”). For example, the speaker in (3) rejects the implicit expectation of the senders that she has time to reply:

(3) (Opening inbox) As if I have time to answer these emails!
~~ I don’t have time to answer these emails.

At the limits of truncation are “Clueless uses”, a subspecies of exclamatory *as if* named after the 1995 romcom featuring this famous Valley Girl exclamation of disgust:

(4) (Gross guy makes an advance) Cher: Ugh, as if!
~~ I would never kiss you.

While in (3) the finite embedded clause *I have time to answer these emails* (the “prejacent”) expresses the targeted expectation, the *Clueless as if* in (4) lacks an overt complement but

1 For detailed comments on our work, we are grateful to Sebastian Bücking, Simon Charlow, Alex Kocurek, and Sarah Zobel. Thanks also to Ana Arregui, Maria Biezma, Lucas Champollion, Alexander Göbel, Simon Goldstein, Michael Johnson, Friederike Moltmann, Kyle Rawlins, Jessica Rett, Matthew Ritchie, Rachel Rudolph, Paolo Santorio, Simon Wimmer, and audiences at SuB 23, SuB 24, Hong Kong University, the New York Philosophy of Language Workshop, the 2019 Central APA, the 2019 Ontario Meaning Workshop, PhLiP 6, and the 2019 Workshop on Clausal Complements and Sentence-Embedding Predicates at NYU for helpful discussion.

2 Terminological aside: we use “exclamatory *as if*” as a cover term for occurrences of *as if* in root clauses, for the full root *as if*-clauses themselves, and for utterances made with these clauses (we motivate our use of “exclamatory” later in this paper).

likewise serves to reject a contextually salient expectation (i.e., that Cher will kiss her would-be seducer). One of our main challenges in this paper is to explain how this denial comes about. As we discuss in §2, exclamatory as if’s also differ both from their multiclausal brethren and from plain negative assertions in a number of important respects, and their idiosyncratic features call out for explanation.

We present our first pass at a semantics for exclamatory as if in §3. This analysis builds on our earlier semantics for non-root as if-phrases in Bledin and Srinivas (2019) reformulated in an event-situation semantic framework including Austinian topic situations (Austin, 1950; Barwise and Etchemendy, 1987; Kratzer, 2019). Previously, we argued that as if-phrases denote “hypothetical comparative” properties of eventualities—for instance, the as if-adjunct in the manner use (1) expresses a modal property, instantiated by the matrix dancing event, of resembling its counterparts in typical worlds where Pedro was possessed by demons. With exclamatory as if’s, it is the topic situation being compared with respect to how it settles the expectation to which the as if utterance responds. The initial proposal is that this hypothetical comparison is fed into an elided sentential negation operator to generate denial of the as if prejacent.

There are difficulties, however, with this negation ellipsis account, so we consider more exotic approaches in §4 that view exclamatory as if’s as meta-conversational rejections, rhetorical questions, or bona fide exclamations. We develop the latter exclamation-based approach in §5 building heavily on Grosz’s (2011) Exclamation-Operator (“EX-Op”) account of optative and polar exclamative constructions. Replacing the sentential negation in our initial analysis with an exclamation operator that contributes the force of denial allows us to meet the desiderata from §2. We conclude in §6 by showing how our account extends to Clueless uses.

2. Characteristic features of exclamatory as if

In addition to same-speaker examples like (3) and (4), root exclamatory as if’s can also occur cross-speaker, where they are commonly used to reject assertions, commands, questions, and other speech acts:

(5) A: Zelda and I are just friends.
   B: (Yeah right.) As if I’m going to believe that!
   ~ I’m not going to believe that.

(6) A: Fetch my slippers!
   B: (Yeah right.) As if I’d ever help you!
   ~ I would never help you.

(7) A: Who is the Prime Minister of Canada?
   B: As if I {know/care}!
   ~ I don’t {know/care}.

---

5 There are parallel exclamatory uses with as though and like, though exclamatory as though is rarer in present-day English and there are no Clueless as though or likes:

(i) Like I have time to answer all these emails!
(ii) Are these petty games fun for you? Canceling my credit cards to what? Show me who’s boss? As though I need them. As though I don’t have my own money. (Corpus of American Soap Operas via Brinton, 2014)
(iii) *{As though! / Like!}
In each of these examples, B rejects a prior expectation of A (or what B takes A to expect), which is expressed by the prejacent of the as if response. Note that exclamatory as if's require an expectation to react to (henceforth the “antecedent expectation”), differing from negative assertions, which can be felicitous out-of-the-blue:

(8) (Waking up first thing in the morning)
A: I’m not feeling well today.
A’: #As if I’m feeling well today!

Exclamatory as if’s also differ from non-exclamatory non-root as if’s, which do not share their denying function:4

(9) Pedro is dancing as if he’s been taking salsa lessons.
¬ Pedro hasn’t been taking salsa lessons.

(10) It smells as if there’s peach cobbler in the oven.
¬ There isn’t peach cobbler in the oven.

There are a number of other distinctive features to be explained. First, exclamatory as if’s are associated with a negative evaluative affect. A speaker using an exclamatory as if does not convey simply that the antecedent expectation is false, but additionally expresses contempt or “sneering” incredulity towards this expectation (i.e., that the holder of the expectation should have known better). Once again, this affect is generally absent in plain negative assertions, as shown in (11):

(11) A: Will you go to the party?
B: As if I’d ever go to a party like that!—??though it isn’t unreasonable for you to expect me to go.
B’: I’d never go to a party like that!—though it isn’t unreasonable for you to expect me to go.

Exclamatory as if’s also differ from their non-root counterparts with respect to licensing of negative polarity items (NPIs). Unlike ordinary if, non-root as if doesn’t license NPIs (or at least is a far less hospitable environment for NPIs):

(12) She took a bow as if {someone/*anyone} was in the theater watching her perform.

(13) *John smells as if he ever got sprayed by a skunk!

On the other hand, as Camp and Hawthorne (2008) and Camp (2012) observe, sarcastic as if’s pattern with regular if in licensing both weak NPIs like any and ever and strong NPIs like lift a finger and last long:

(14) A: Who won Eurovision?
B: As if {anybody cares/I’ll ever tell you}!

(15) As if John lifted a finger to help when I asked!

(16) As if that relationship is going to last long!

4That said, (9) and (10) seem to convey that the speaker doesn’t know that Pedro has taken salsa lessons and she doesn’t know that there is peach cobbler in the oven. We suspect that this extra information can be calculated as a scalar implicature, though we do not have space to explore this proposal further.
Thus, despite our goal of accounting for the various uses of *as if* with as uniform an account as possible, our final analysis must be sensitive to this difference in NPI licensing between root and non-root cases.

Unlike non-root *as if*s, exclamatory *as if* is also highly inflexible, occurring only at the start of a sentence and never in sentence-medial or final position:

\[(17) \quad \{\text{As if}\} \quad \text{Jack fell down} \quad \{\text{*as if}\} \quad \text{and} \quad \{\text{*as if}\} \quad \text{Jill came tumbling after} \quad \{\text{*as if}\}!\]

While Camp and Hawthorne (2008) persuasively argue that this is a purely syntactic constraint, exclamatory *as if* must take scope over the entire sentence that follows, unlike regular sentential negation, which can take scope under other operators:

\[(18) \quad \text{As if Messi scored and Barcelona lost!} \quad \text{(only AS IF} \gg \text{CONJ reading available)}\]
\[(19) \quad \text{As if anybody must know about our plan!} \quad \text{(only AS IF} \gg \text{MUST reading available)}\]

The table below collects the above observations (minus the left-fronting syntactic requirement), which constitute desiderata to explain for any satisfactory semantic analysis. We include one further desideratum corresponding to our goal of providing a unified cross-categorical account of *as if* by incorporating conditionality and comparativity into the analysis of root *as if*-phrases, just as Bledin and Srinivas (2019) do for adjunct and complement *as if*-phrases.

<table>
<thead>
<tr>
<th>Desideratum</th>
<th>Description</th>
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<tr>
<td>Prejacent Denial</td>
<td>Exclamatory <em>as if</em> conveys the denial of the prejacent.</td>
</tr>
<tr>
<td>Limited Distribution</td>
<td>Exclamatory <em>as if</em> utterances must occur in the wake of an implicit or explicit contextual expectation; they cannot occur out-of-the-blue.</td>
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<tr>
<td>Negative Affect</td>
<td>Exclamatory <em>as if</em>s are associated with a negative evaluative affect directed at the antecedent expectation (or its holder).</td>
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<td>Iffiness &amp; Comparativity</td>
<td>The semantics of root <em>as if</em>-clauses has conditional (<em>iffy</em>) and comparative (<em>asy</em>) dimensions.</td>
</tr>
</tbody>
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In the next section, we develop a preliminary analysis of exclamatory *as if* that posits an elided sentential negation operator. We’ve already seen examples such as (8), (11), (18), and (19) showing that exclamatory *as if* constructions have properties different from ordinary negative assertions, so the analysis in §3 is unlikely to be the full story. Nevertheless, consideration of this proposal is useful for introducing many of the semantic details necessary in analyzing these utterances as hypothetical comparative constructions.

3. First pass: elided negation account

Our first stab at a semantic analysis stems from the observation that in many contexts where an exclamatory *as if* construction is used, an *It’s not as if...* construction with overt negation can be used (almost) interchangeably to deny the antecedent expectation:

\[(20) \quad A: \quad \text{Walter called in sick again. Poor guy!} \quad \quad B: \quad \text{C’mon, \{it’s not as if/as if\} he’s actually sick!}\]
(21) A: What is the capital of Azerbaijan?
B: Why are you asking me? {It’s not as if/As if} I know the answer!

(22) {It’s not as if/As if} I’m an alcoholic! I had only two beers.

Motivated by such examples, one might take exclamatory as if’s to involve an elided sentential negation operator, such that (23a) is equivalent to (23b):

(23) a. As if Walter is sick!
   b. It’s not as if Walter is sick!

In the subsections below, we develop this proposal in detail, employing an upgraded version of the hypothetical comparative (HC) semantics for as if-phrases proposed in Bledin and Srinivas (2019). An overview of this account is first provided in §3.1.

3.1. Hypothetical comparative semantics for as if

We motivate our HC semantics by interpreting the manner use (1), repeated below as (24):

(24) Pedro danced as if he was possessed by demons.

Intuitively, we take (24) to convey that Pedro’s actual dancing resembles his dancing in possible situations where he was possessed by demons (Kasper, 1987; Bücking, 2017). To formally implement this proposal, we adopt a Kratzer-style possibilistic situation semantics, which is a conservative extension of possible worlds semantics (Kratzer, 1989, 2019). Let \( \mathcal{S} \) be a set of possible situations standing in part-whole relations to each other: \( s \leq s' \) iff \( s \) is part of \( s' \). Each situation \( s \) is related to a unique maximal element \( w_s \in \mathcal{W} \subset \mathcal{S} \), the world of \( s \) (the situations in a world form a join semi-lattice). Davidsonian event semantics (Davidson, 1967; Parsons, 1990; Landman, 2000) can be embedded in this framework by identifying the set of eventualities with a subset of “exemplifying” situations \( \mathcal{E} \subset \mathcal{S} \) (see Kratzer, 2019), which are linked to their participants via thematic relations. Because eventualities and other situations are world-bound, we help ourselves to the machinery of Lewis’s (1968, 1986) counterpart theory to identify “similar” situations across possible worlds (following Kratzer, 2019; Schaffer, 2005; Schwarz, 2009; Arregui et al., 2014, among others):

(25) **Counterpart relation between situations:** \( C(s)(s') \) iff \( s' \) is a counterpart of \( s \).

Stated in terms of counterparts, a better though still rough formulation of our analysis is that (24) reports the existence of a past event \( e \) of Pedro’s dancing that resembles its counterparts in worlds in which he was possessed.

However, not just any counterparts should be taken into consideration. Presumably, there are worlds in which Pedro was possessed yet danced in a calm and sedate manner, and we want to screen these off. To achieve this, Bledin and Srinivas (2019) propose that as if-phrases select for stereotypicality orderings over logical space (perhaps induced by Kratzerian “ordering sources” (Kratzer, 1981, 1991, 2012); see also Asher and Morreau, 1991; Veltman, 1996):\(^5\)

(26) **Stereotypicality relation between worlds:** \( v \leq_w u \) iff \( v \) is at least as typical as \( u \) from the perspective of what counts as normal in \( w \).

\(^5\)While one might look instead to Lewis’s similarity relations to restrict the selection of counterparts, Bledin and Srinivas (2019) argue that there are significant problems with a similarity-based approach.
Bledin and Srinivas (2019) take stereotypicality to sufficiently restrict the set of counterpart situations that need to be considered; however, in many cases we are interested not in the most typical worlds * simpliciter but rather in the most typical worlds where certain relevant circumstances in the world of evaluation continue to hold.\(^6\) So in the updated version of our theory, we more closely follow Kratzer’s (1977, 1981, 1991, 2012) influential contextualist semantics for modals in assuming that context will supply not only normalcy relations but also a “circumstantial modal base” as defined in (27) that maps each world to a set of worlds in which relevant circumstances of the input world hold:\(^7\)

\[(D, \leq)\] consists of a circumstantial base \(D\) where \(D(w)\) is the set of worlds in which certain relevant circumstances of \(w\) hold, and \(\leq\) maps each world \(w\) to a normalcy relation \(\leq_w\) (as defined in (26)).

Using the contextual parameters in (25) and (27), we define a selection function \(F_c\) that takes a situation \(s\) and proposition \(p\) (the characteristic function of a set of situations) as arguments and returns the counterparts of \(s\) in all the most normal \(p\)-worlds where relevant circumstances of \(w_s\) hold and a counterpart of \(s\) exists:\(^8\)

\[(28)\quad \text{Selection function:} \quad \exists s' \in F_c(s)(p) \iff \text{the following all hold:}\]

\[\begin{align*}
\text{a.} \quad & C_c(s)(s') \quad (s' \text{ is a counterpart of } s) \\
\text{b.} \quad & \exists s''(p(s'') \land s'' \leq w_{s'}) \quad (s' \text{ inhabits a world with a } p\text{-situation}) \\
\text{c.} \quad & D_c(w_s)(w_{s'}) \quad (s' \text{ is in a world where relevant circumstances of } w_s \text{ hold}) \\
\text{d.} \quad & \forall w((\exists s''(p(s'') \land s'' \leq w) \land D_c(w_s)(w) \land \exists s''(C_c(s)(s'') \land s'' \leq w)) \rightarrow w_s \leq_{c,w_s} w_s) \\
\end{align*}\]

\((w_{s'}\) is at least as typical with respect to \(w_s\) as any relevant circumstantial world with a \(p\)-situation and a counterpart of \(s\)).

Once these relevant counterparts are obtained via (28), the anchor situation \(s\) can be compared to its counterparts along a parameterized dimension of resemblance, as defined in (29). While our target example (24) clearly involves a manner comparison, we don’t lexically associate *as if* with manner because of examples like (30) where the *as if*-adjunct is used to convey a non-manner (or at least non-obviously-manner) feature of the matrix event, namely its location:

\[(29)\quad \text{Resemblance relation between situations:} \quad R(s)(s') \quad \text{iff } s' \text{ resembles } s. \quad \text{The relation } R \quad \text{encodes the respect(s) of comparison and how ’close’ } s \text{ and } s' \text{ need to be in the relevant respect(s) to count as resembling.}\(^9\)

\[(30)\quad \text{Context: The king’s policy is to meet nobles in his throne room and commoners in the hall. Occasionally he makes exceptions.}\]

Though Annie was a commoner, the king met with her as if she were a noblewoman. \(\sim\) The king met with Annie in the throne room.

\(^6\)We are grateful to Alex Kocurek (p.c.) for helpful discussion of this point.

\(^7\)This formalism departs slightly from that used by Kratzer, whose conversational backgrounds are functions from worlds to sets of propositions.

\(^8\)This definition is a modified version of the selection function defined in Bledin and Srinivas (2019).

\(^9\)While we treat \(R\) as a contextually supplied primitive, one could derive it from a more basic relation of similarity between points in one of Umbach and Gust’s (2014) multi-dimensional “attribute spaces” (or Gärdenfors’s 2000 “conceptual spaces”). This would introduce gradability and so allow for a treatment of degree modification of *as if*-phrases (almost as if, quite as if, and so on).
Putting together all these pieces, we propose the following semantic entry for *as if*:

(31) Entry for *as if*: \[ \text{[as if]}^\text{c,g} = \lambda p_{(s,t)} \cdot \lambda s_x, \forall s'(s' \in F_c(s)(p) \rightarrow R_c(s'(s'))) \]

In words: *as if* takes a propositional argument \( p \) and returns a property of situations, which holds of \( s \) when it \( R_c \)-resembles all counterparts selected by \( F_c(s)(p) \).

To fully analyze our example (24), we import our *as if* entry (31) into an LF clausal architecture involving Austinian *topic situations* (Austin, 1950; Barwise and Etchemendy, 1987; Kratzer, 2019), which generalize Klein’s (1994) *topic times*. Topic situations encode what statements are *about* and will be crucial to our analysis of exclamatory *as if*s. The implementation below draws heavily on Schwarz (2009).

To interpret this LF, we help ourselves to several off-the-shelf ingredients:

- Standard treatment of determiner phrases:
  
  \[ \begin{align*}
  \text{[Pedro]}^{c,g} &= \text{Pedro} \\
  \text{[he]}^{c,g} &= g(x)
  \end{align*} \]

- Neo-Davidsonian lexical semantics (Carlson, 1984; Parsons, 1990; Krifka, 1992):
  
  \[ \begin{align*}
  \text{[dance]}^{c,g} &= \lambda e_v.\text{dance}(e) \\
  \text{[possess-by-demons]}^{c,g} &= \lambda e_v.\text{possess-by-demons}(e)
  \end{align*} \]

- Thematic roles and type shifting from Champollion (2017):
  
  \[ \begin{align*}
  \text{[Agent]}^{c,g} &= \lambda e_v.\text{Ag}(e) \\
  \text{[Theme]}^{c,g} &= \lambda e_v.\text{Th}(e) \\
  \text{Type shifter:} \quad &\lambda \theta_{(v,e)}, \lambda x_e.\lambda e_v.\text{V}(e) \wedge \theta(e) = x
  \end{align*} \]

Note that we treat *as if* as a lexicalized idiomatic expression whose meaning isn’t derived from the standard meaning of *if*-clauses composed with the standard meaning of *as*. See Bledin and Srinivas (2019) for a battery of syntactic and semantic arguments for an idiomatic treatment of both root and non-root *as if*s.
Exclamatory As If

- Perfective and imperfective aspectual operators:
  \[ \text{PF}^{\text{c-}} = \lambda s. \lambda V. \exists e(e' \leq s \land V(e)) \]
  \[ \text{IMPF}^{\text{c-}} = \lambda s. \lambda V. \forall s'(\mathcal{R}(s')) \rightarrow \exists e(e' \leq s' \land V(e)) \]

where \( \mathcal{R} \) in the clause for the imperfective operator is a contextually/linguistically determined accessibility relation whose range of interpretations correspond to temporal, generic, and modal flavors of imperfectivity (see Arregui et al., 2014, building on Cipria and Roberts, 2000). In the case of (24), \( \mathcal{R} \) returns time-slices of the topic situation.

- Referential approach to tense (Partee, 1973; Kratzer, 1998; Hacquard, 2006) combined with Kratzer’s (1998) analysis of “sequence of tense” using zero tense, but implemented in a situation semantics where tenses are situational pronouns (\( s_{\text{topic}} \) is a contextually supplied topic situation, \( \tau(s) \) is the “runtime” of situation \( s \) (Krifka, 1989), UT is the utterance time):

  \[ \text{PF}^{\text{c-}} = s_{\text{topic}}. \text{Defined only if UT} \subseteq \tau(s_{\text{topic}}). \]
  \[ \text{Past}^{\text{c-}} = s_{\text{topic}}. \text{Defined only if } \tau(s_{\text{topic}}) < UT. \]
  \[ \text{Topic}^{\text{c-}} = g(s) \]

- Schwarz’s (2009) Topic operator (the integration of Topic with the situational treatment of tenses builds on an earlier version of Kratzer, 2012; see also Ramchand, 2014):

  \[ \text{Topic}^{\text{c-}} = \lambda p(s). \lambda s'. \lambda s. C_e(s'(s')) \land p(s) \]

Assuming that binding is achieved by raising the matrix tense \( \text{Past} \) and subject Pedro, (24) is interpreted as follows:

\[ \text{PF}^{\text{c-}} = \lambda s. \lambda s'. \lambda s. C_e(s'(s')) \land p(s) \]

Defined only if \( \tau(s_{\text{topic}}) < UT. \)

In words: The topic situation, which is located in the past, contains a dancing event \( e \) by Pedro that \( R_e \)-resembles its counterparts in all the most stereotypical circumstantial worlds in which Pedro was possessed by demons during (counterparts of) the topic situation. Raised on horror films like The Exorcist, a hearer can infer that a speaker who utters (24) is conveying that Pedro danced wildly.

3.2. Extending the HC semantics to exclamatory as if

We suggested at the beginning of this section that (39a) are (39b) are equivalent:

a. As if Walter is sick!

b. It’s not as if Walter is sick!

\( \sim \) Walter isn’t sick.

Assuming that our core HC semantics carries over, we can interpret these sentences by applying our situation-semantic as if entry (31) and letting a standard Neg operator (of type \( (t, t) \)) scope over the as if-phrase but below Topic:
In words: The topic situation, which is located in the present, doesn’t resemble all its counterparts in the most stereotypical worlds in which Walter is sick. Note that unlike in (24) where the matrix verb dance provides the situation argument for the as if-adjunct (i.e., a dancing event that is part of the topic situation), the situation argument of as if in (39) is now saturated with the topic situation itself.

Now, this cannot be the whole story. To derive the inference that Walter isn’t sick, our semantics must be supplemented with ancillary meaning postulates that fix both the topic situation and the setting of the resemblance relation appearing in (40). First, we propose that exclamatory as if s carry the following “Reactivity” presupposition, which accounts for their restricted distribution:

(41) **Meaning postulate 1:** Exclamatory as if s require that their propositional argument has been previously asserted or is otherwise expected in the context and is therefore apt for ‘denial’ (cf. Cinque, 1976 on the Italian negative particle mica; see Frana and Rawlins, 2015 for discussion).

This Reactivity condition is satisfied in (20), where A expects that Walter is sick. The second meaning postulate ensures that B’s response targets A’s expectation:

(42) **Meaning postulate 2:** Exclamatory as if s are about whether the expectation to which they respond holds. Correspondingly, the topic situation against which an exclamatory as if is evaluated settles the matter of this antecedent expectation.

According to (42), B’s response concerns whether Walter is actually sick, and so the topic situation $s_{topic}$ entering into (40) consists of Walter in his current state of health. The final meaning postulate concerns the notion of resemblance relevant to the evaluation procedure for exclamatory as if s:

(43) **Meaning postulate 3:** Exclamatory as if s are evaluated using a resemblance relation $R_c$ that concerns whether situations agree with one another in how they settle whether the antecedent expectation holds: $R_c(s)(s')$ iff both $s$ and $s'$ verify this expectation, both falsify this expectation, or neither situation verifies or falsifies this expectation.

In our example, (43) requires that $R_c(s)(s')$ iff both $s$ and $s'$ verify that Walter is sick, both falsify that he is sick, or neither situation verifies or falsifies that he is sick. Fleshed out along these lines, (40) amounts to the condition that Walter’s current health situation fails to resemble its counterparts where Walter is in bed with a fever, throwing up, or exhibiting other typical symptoms of illness, in respect of whether it verifies or falsifies that Walter is sick—that is, while the relevant counterparts verify that Walter is sick, the actual situation does not. As such, B’s response is a somewhat roundabout way of conveying that Walter isn’t sick by getting A to consider typical situations where he is sick and asserting that the reality of Walter’s health situation deviates from these.

Schwarz (2009) shows how topic situations can be derived from the current Question Un-
der Discussion or QUD (Roberts, 1996, 2012; Ginzburg, 1996; van Kuppevelt, 1996; Büring, 2003). Framed in terms of QUDs, our proposal is that exclamatory as if s respond to the QUD of whether the antecedent expectation is true. This might be considered to conflict with cases where there is a different explicit QUD already in place:

(44) A: Who won Eurovision?
B: As if I care!

However, we propose that in such cases an as if response can change the topic. While A’s initial question introduces the QUD Who won Eurovision, which determines a topic situation consisting of a particular individual winning the contest, A also signals that she thinks B might care enough about Eurovision to be informed about the winner. B’s response addresses this expectation, pushing the new QUD Whether B cares who won Eurovision onto the topic stack. This new QUD isn’t unrelated to the original—and is therefore easily accommodated—because B’s negative answer reveals that A’s initial question is practically unanswerable in the current discourse context.

3.3. Taking stock: what works and what doesn’t in the elided negation account

To its credit, the sentential negation account augmented with our trio of interwoven meaning postulates predicts prejacent denial while maintaining the core HC semantics from Bledin and Srinivas (2019) with its iffiness and asiness—a positive step towards our goal of offering a unified analysis of as if across its various uses. The Reactivity condition also accounts for the limited distribution of exclamatory as if s to contexts with a salient (explicit or implicit) expectation in place. Furthermore, the fact that exclamatory as if constructions license NPIs under this account is a direct consequence of the elided negation operator, and can therefore be explained by downward entailment (Fauconnier, 1975; Ladusaw, 1979; von Fintel, 1999), non-veridicality (Giannakidou, 1998), scope-licensing (Barker, 2018), or some other licensing condition met by ordinary negative contexts.

However, there are significant difficulties with this proposal, many of which have to do with the properties of the denial being not quite what is predicated under a simple sentential negation analysis. First, as discussed in §2, exclamatory as if s are accompanied by a negative evaluative affect, which is left unaccounted for on the current proposal. One might try to explain this negative affect as an extra semantic effect contributed by the distinctive “dripping” tone that accompanies many exclamatory as if utterances. However, this special sarcastic intonation isn’t required, and even without it exclamatory as if s have mocking sardonic overtones.

The elided negation account also leaves mysterious why exclamatory as if must take widest scope, as previously shown in examples (18) and (19). After all, the most natural reading of (45) has conjunction scoping over the negation:

(45) It’s not as if I have time to play tennis but I want to.

Furthermore, exclamatory as if and It’s not as if constructions pattern differently in other important respects that point to the former being expressives. Unlike It’s not as if constructions, which can be straightforwardly affirmed or denied, exclamatory as if s fail what Kaufmann (2012) calls the “That’s {true/false}-test”, which suggests that they have expressive rather than run-of-the-mill descriptive content:
Another hallmark of expressive language is unembeddability, which is exhibited by exclamatory *as if* but not by *It’s not as if* constructions. Despite having the morphosyntax of embedded clauses, exclamatory *as if*s are generally unembeddable. This is unlike *It’s not as if* clauses, which can be embedded in at least some environments:

(48) *Mary {knows/believes/thinks} that as if Santa Claus exists.

(49) *If a thief broke in then as if he would find the silver.

(50) I also think we have to remember that it’s not as if it’s the same audience that’s watching all of these debates in succession. (COCA)

However, it’s not clear that we should put much weight on this data as the unembeddability of exclamatory *as if* is already predicted by the left-peripheral syntactic constraint that renders embedded occurrences ungrammatical.

Camp and Hawthorne (2008) offer a related argument for the expressivity of exclamatory *as if* that appeals to Davidsonian belief attribution constructions (after Davidson, 1968) such as (51) and (52). They observe the following contrast:

(51) ??As if anyone even listens to what he has to say! Donald believes that.

(52) It’s not as if anyone even listens to what he has to say. Donald believes that.

Assuming that *that* in (52) anaphorically retrieves the content of the preceding sentence, the contrast between (51) and (52) provides additional support for exclamatory *as if* constructions not having ordinary descriptive meaning that can serve as the content of belief.

### 4. Into exotic waters

Summing up: exclamatory *as if* is funky in many ways that the elided negation account fails to predict. Turning to more exotic proposals, another approach that we seriously considered in a previous iteration of this work is to treat exclamatory *as if*s as meta-conversational claims involving Repp’s (2006, 2013) “common-ground managing” operator FALSUM. Informally, FALSUM(φ) conveys the speaker’s belief that meeting her discourse goals requires keeping the proposition [φ]c,g out of the common ground, or equivalently, that the speaker objects to the truth of [φ]c,g. FALSUM is associated with a number of desirable properties for our current purposes: FALSUM-utterances are infelicitous out-of-the-blue (Repp, 2013), contribute expressive content (Gutzmann, 2013), and have wide-scope interpretations of denial. However, the existing literature takes for granted that FALSUM doesn’t license NPIs (see for instance Frana and Rawlins, 2015). Moreover, it isn’t clear how to account for the negative evaluative

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11 Corpus of Contemporary American English: available online at http://corpus.byu.edu/coca/
Another option suggested by Jessica Rett (p.c.) is to analyze exclamatory *as if* s as rhetorical questions (RQs), which are similarly polarity-reversing. This option is intriguing as (positive) RQs license both weak and strong NPIs, however it is difficult to see how exclamatory *as if* s can be interpreted as RQs given that many semantic accounts of RQs in the literature rely on properties specific to interrogative constructions. Han (2002), for instance, argues that the polarity reversal in RQs is contributed by a wh-item (covert *whether* in the case of polar RQs), which is interpreted as negative polarity or a negative quantifier for pragmatic reasons. More troublingly, Caponigro and Sprouse (2007) argue that RQs resemble ordinary questions in a number of important respects, such as in allowing for answers, and these inquisitive features aren’t shared by exclamatory *as if* s:

(53)  
   a. A: Is research ever easy? B: {Sometimes. / Never.}  
   b. A: As if research is ever easy! B: #{Sometimes. / Never.}  

To our mind, a more promising approach is to treat exclamatory *as if* utterances as bona fide exclamations, members of a general class of expressive utterances whose canonical speech act function is to *exclaim*. This class also includes optative constructions, used by speakers to express a hope, wish, or desire that something obtains or had obtained without any overt lexical marker for desirability (Rifkin, 2000; Grosz, 2011; Biezma, 2011):

(54) If I had only listened to my parents! (Quirk et al., 1985)

It also includes polar exclamatives used to express shock, awe, or dismay without containing a lexical item that directly encodes these emotions (Grosz, 2011; see also Rett, 2011 on the closely related class of degree exclamatives):

(55) That you could ever want to marry such a man! (Quirk et al., 1985)

Exclamatory *as if* s, optatives, and polar exclamatives share a number of common properties. First, these constructions have a similar grammatical shape involving *insubordination* (Evans, 2007)—while they take the form of unembedded clauses, they retain the morphosyntax of embedded clauses. Second, optatives and polar exclamatives are intuitively exclamations where a speaker directly expresses an emotive or evaluative attitude towards a proposition, rather than straightforwardly describing reality. Third, optatives and polar exclamatives also exhibit characteristic marks of expressive content (see Grosz, 2011). Given these similarities, we pursue an exclamation-based approach in the remainder of this paper.

5. Conventionalized EX-clamation

In this section, we develop a formal analysis of exclamatory *as if* utterances as exclamations, building on Grosz’s (2011) Exclamation-Operator account of optative and polar exclamative

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12 Camp and Hawthorne (2008) argue for an “illocutionary-force theoretic” treatment of sarcastic *as if*s/likes on which they involve a denial operator, though they do not develop this proposal in detail. The FALSUM analysis might be regarded as a precisification of Camp & Hawthorne’s denial approach. We regard our exclamation-based account in §5 as another precisification of their view.

13 Aside from the fact that exclamatory *as if* s do not include wh-elements, another problem with a Han-style account is that RQs are re-interpreted as negative assertions via post-LF processing, so treating exclamatory *as if* s in this way would just reintroduce the worries with the elided negation account from §3.3.
constructions (see also the related conventionalized speech act accounts in Zaefferer, 2006; Kyriakaki, 2008; Rett, 2011). According to Grosz, both optatives and polar exclamatives involve a general expressive operator EX that associates with a contextually provided scale, and these constructions are felicitously uttered only when the proposition on which EX operates is above a contextually determined threshold on this scale. By modulating the scale dimension, utterances involving EX can express a range of emotive and evaluative attitudes towards the modified proposition, given its threshold-exceeding status on the scale.

Within our event-situation semantic framework, this can be implemented as follows:

\[(56)\]  
**Scales:** A scale \(S \subseteq \mathcal{P}(\mathcal{P}) \times \mathcal{P}(\mathcal{P})\) is a set of ordered pairs of propositions, where we write \(p \geq_S q\) (‘\(p\) is at least as high as \(q\) on \(S\)’) iff \(\langle p, q \rangle \in S\). \(p >_S q\) abbreviates \(p \geq_S q\) but \(q \not\geq_S p\).

\[(57)\]  
**Entry for EX:** \(\llbracket \text{[Force} \text{EX} S \text{]} [\langle s, t \rangle \text{TP}] \rrbracket^c\) is felicitous iff \(\text{[TP]}^c >_S \text{THRESHOLD}(c)\), where \(\text{THRESHOLD}\) is a function from a context to a proposition that is high on the contextually relevant scale.

Feed in a bouletic scale \(S_c\) keyed to the speaker’s preferences and we get an optative reading, feed in an inverse-likelihood scale \(S_c\) that reflects what the speaker considers unlikely and we get a polar exclamative reading, and so forth. However, while Grosz discusses examples that have multiple exclamatory readings (which is why he wants to keep EX general), exclamatory as if’s can be used only to express the speaker’s incredulous denial of the antecedent expectation:

\[(58)\]  
A: Want to play a game of tennis?  
B: As if I have time for tennis!  
\(\leadsto\mbox{Incredulous rejection:} [\mbox{It’s preposterous to expect that}] \mbox{I have time for tennis!}\)  
\(\not\leadsto\mbox{Optative:} [\mbox{I want it to be that}] \mbox{I have time for tennis!}\)  
\(\not\leadsto\mbox{Exclamative:} [\mbox{I’m surprised that}] \mbox{I have time for tennis!}\)

We propose that this “preposterousness” associated with exclamatory as if’s can be captured using an expressive operator much like Grosz’s EX, which maps a propositional argument onto expressive content to produce a felicity-conditional utterance. Unlike Grosz’s EX, however, which can take on a variety of expressive flavors depending on context—the same exclamation that is interpreted as a polar exclamative in one context can be interpreted as an optative in another—the specialized expressive operator in exclamatory as if constructions (which we also denote using ‘EX’) is tailor-made for incredulous denial. More specifically, we assume that this ‘rejection’ operator EX mandatorily selects for a speaker unlikelihood scale—the same kind of scale that occurs in polar exclamative interpretations—and a threshold (call this ‘BS\(_c\)’) above which propositions are deemed so preposterous as to defy belief. This is why speakers who make as if exclamations are conventionally understood to express incredulous rejection of the antecedent expectation, whether or not they talk with a snarky dripping tone.

We assume that the propositional argument to the rejection operator EX is still derived using our HC semantics for as if supplemented with the three meaning postulates in §3.2. For example, we interpret (23a) as follows:

\[14\] We assume that EX is located in Rizzi’s (1997) Force. Grosz (2011) himself suggests that the EX operator occupies the spec-CP position, but we follow Grosz’s predecessor Gutiérrez Rexach (1996) whose EXC operator is an illocutionary force operator.
Exclamatory As If s

(59) \[
[F_{\text{EX}} S_{\text{Sp-Unlikelihood}}] [\text{TP}_{(s,t)}] \text{Present}[\lambda s'[\text{Topic}(s,t) \text{as if} \text{TP}_{(s,t)}]\langle s,t \rangle \text{as if} \langle s,t \rangle] \text{TP}_{(s,t)}]
\]

In words: the as if exclamation (23a) is felicitous in c iff the proposition that Walter’s current health situation resembles its counterparts in the most stereotypical worlds wherein he is sick—in respect of how these situations settle the question of whether Walter is sick—exceeds the BS threshold on B’s uncertainty scale.

This specialized EX-Op analysis fares much better than the earlier negation ellipsis account from §3 with respect to meeting the various desiderata listed at the end of §2. Interpreting exclamatory as if’s as EX-utterances involving the incredulous rejection operator EX accounts for both their denying function and negative affect. The Reactivity condition from §3.2 accounts for their limited distribution to contexts with a salient expectation in place. The wide-scoping behavior of exclamatory as if’s can be explained by restrictions on coordinating exclamations with assertions and other speech acts. As for the NPI data, the EX-Op approach opens up the possibility of explaining this in terms of the structure of the scale that the rejection operator EX associates with. Grosz (2011) observes that polar exclamatives license NPIs while optatives do not, and he explains this in terms of the fact that the unlikelihood scales against which polar exclamatives are evaluated are anti-additive (Zwarts, 1998) while the bouletic scales against which optatives are evaluated are not. On our proposal, exclamatory as if’s are evaluated against the same unlikelihood scales as polar exclamatives, so their licensing of NPIs might be explained in the same way.

6. Conclusion: Clueless uses

We conclude by briefly discussing how our analysis of exclamatory as if’s extends to Clueless uses. Like “exclamatory monoclauses” featuring overt prejacents, Clueless as if’s are limited to contexts where there is a salient expectation to deny:

(60) (Out-of-the-blue) #As if!

Moreover, Clueless uses invariably express sarcasm, in that their denial function has a negative evaluative overlay on which the speaker mocks or dismisses the participant holding the rejected assumption. To carry over the EX-Op analysis to Clueless uses whereby a speaker denies an antecedent expectation that isn’t explicitly expressed, we assume that discourse contexts come
equipped with a (possibly empty) ordered set of propositional discourse referents that can be referred to in subsequent discussion (Bittner, 2011; Murray, 2014). Where $p^\top$ denotes the most prominent top-ranked propositional discourse referent in a context (assuming there is one), we postulate the following LF for Clueless as if:

$$
\text{ForceP} \\
\text{Force} \\
\text{EX} \quad \text{SSpeaker-Uncertainty} \quad \text{Present}_t \\
\text{Topic} \quad (s,t) \quad \text{as if} \quad p^\top
$$

The anaphoric component of Clueless as if's is connected to some of their interpretive and distributional differences with exclamatory monoclauses. First, while the exclamatory monoclauses can be used to contest presuppositions or implicatures associated with a previous utterance, Clueless uses can target only at-issue content:

(61) A: John has stopped smoking  
B: As if he ever used to smoke. ~ John never uses to smoke. 
B': As if! ~ John hasn’t stopped smoking.

This can be explained by the fact that at-issue content is always more salient than “projective” presuppositional or implicated content.

Second, while Clueless as if can be uttered in response to assertions and polar questions but not constituent questions, exclamatory monoclauses can respond to all of these speech acts:

(62) A: Is Beyonce coming to the party? 
B: {As if!/As if she’s coming!}

(63) A: I hope to see Beyonce tonight. Who’s coming to the party? 
B: {#As if!/As if Beyonce is coming!}

Assuming that A's question in (62) “highlights” or suggests the answer that Beyonce is coming (as argued by Roelofsen and van Gool, 2010; Starr, 2014; Roelofsen and Farkas, 2015), B can use a Clueless as if to deny this and so negatively answer A's question. In contrast, A’s constituent question in (63) doesn’t highlight any of its answers and so a Clueless as if cannot be used in response (though B can still use an exclamatory monoclause to deny A’s expectation that Beyonce is coming, which was previously expressed but isn’t under immediate discussion).

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Reciprocating *same*¹
Keny CHATAIN — MIT

**Abstract.** *same* can appear with a complement (the external construction) or associating with a plural element in the sentence (the internal construction). This type of alternation is observed with other relational modifiers as well (e.g. *enemy*, *neighbor*). However, *same* is unique in also being able to associate with the singular distributive quantifier *every* in the internal construction (e.g. *every child read the same book*). Here, I propose to derive this unique behavior from two independently evidenced phenomena: plural properties of *every* (Kratzer, 2000) and *same*’s scope-taking (Barker, 2007). Together, these two facts explain *same*’s behavior: by taking scope, *same* is able to enter levels of hierarchies where *every* behaves like a plural. The merit of this analysis is to provide a principled type-driven difference between *same* and other relational modifiers, which, I argue, is missed in other analyses.

**Keywords:** same, scope, relational modifier, reciprocal, every, cumulative readings.

1. Introduction

*same* can appear in two different constructions: in its external construction, *same* takes an *as*-complement; in the internal construction, *same* lacks such a complement and seems dependent for its interpretation on another element in the sentence, typically a plural (e.g. *Angela and Joshua*). I will call this element the *associate*.

(1) a. **External same.**
   Angela read the same book as Joshua.

   b. **Internal same.**
   Angela and Joshua read the same book.

Just like English, many languages use the same word in these two constructions, calling for unification (Charnavel, 2015; Dotlačil, 2010). Furthermore, the meanings of *same* in the two constructions are systematically related; namely, “*Angela and Joshua read the same book*” is true just in case “*Angela and Joshua read the same book as each other*”.

Taking intuition from this paraphrase, one could say that internal *same* is a “reciprocated” version of external *same*. Call this the reciprocal theory of *same*. The reciprocal theory of *same* seems strengthened by the fact that other modifiers than *same* show a reciprocal alternation between internal and external constructions (Charnavel, 2015).

(2) a. **External enemy:**
   Angela is an enemy of Joshua.

   b. **Internal enemy:**
   Angela and Joshua are enemies.

(3) a. **External neighbor:**
   Angela is a neighbor of Joshua.

   b. **Internal neighbor:**
   Angela and Joshua are neighbors.

The reciprocal theory of *same* however is challenged by a minimal variation on (1b), where the subject is replaced by a singular distributive quantifier, like *every*.

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(4) Every child read the same book.
If we try to construct a paraphrase for (4) in terms of the external reading, as we did for (1b), we form the ungrammatical (5):

(5) *Every child read the same book as each other.
In addition, the modifiers neighbor and enemy, which could appear in an internal construction, do not seem to license singular distributive quantifiers, like same:

(6) a. # Every poet is a neighbor.
   b. # Every poet is an enemy.2

Even leaving aside the reciprocal theory of same, (4) seems to lead to paradoxes. While every generally licenses inferences down to atoms, these inferences do not obtain when every is an associate of same (cf. (8)). These inferences suggest that either we must revise standard assumptions of every in this case or that some element outscopes every in that sentence.

(8) Every child read the same book. → # Jack read the same book.

All in all, this missed inference explains why sentences of the form of (4) have often required extra machinery in previous works (Brasoveanu, 2011; Dotlačil, 2010). In this paper, I propose a new solution to the challenge raised by (4). The solution I propose rescues the reciprocal theory that initially seemed so compelling.

The rationale behind this solution follows these steps: in the first section, I present standard arguments that at some level of LF, a singular quantifier like every makes available a plurality; in the second section, I construct an argument from Solomon (2009) that same must take scope at LF (Barker, 2007). Tying the facts from these two sections together, I conclude: by taking scope, same is able to enter domains of LF where every makes available a plurality. In the third section, I lay out the details of the reciprocal theory of same, whereby internal same is a reciprocal version of external same and requires a plural associate. Then, I proceed to show how the facts discovered in the first two sections explain why same can associate with every in (4). The fourth section presents some predictions of this theory. The fifth section compares the merits of this solution to previous solutions and points out a systematic over-generation issue faced by previous accounts; the solution defended here evades this problem.

2. Where singular every behaves like a plural
In this section, I present arguments from the literature that every makes available a plurality at some stage of the derivation. Several approaches to the denotation of every can make sense of these observations but I will present and adopt the proposal by Champollion (2010), because it is technically simpler and meshes better with the theory of same to be presented.

The first argument is the observation that every in object position gives rise to cumulative readings (cf. (9a), Schein (1993); Kratzer (2000); Haslinger and Schmitt (2018)), much like a definite plural (cf. (9b)). This cumulative reading is not predicted by a standard generalized quantifier approach to the meaning of every.

In the intended meaning of the poets are enemies of each other
(9)  a.  The 3 copy-editors caught every mistake.
    ⇐⇒ every copy-editor caught a mistake
    and every mistake was caught by a copy-editor.

    b.  The 3 copy-editors caught the 15 mistakes.

These examples could be taken to show that every mistake may sometimes denote the plurality of all mistakes. However, the example in (10) from Schein (1993) shows that when read cumulatively, every still behaves like a distributive quantifier with respect to elements in its scope. Thus, the numeral two new plays can only be read distributively (two new plays per player), rather than cumulatively (two new plays in total).

(10) Three video games taught every quarterback two new plays.

A second argument that every makes available a plurality at some level of composition comes from the fact that every allow modification by expressions that normally target plural events. For instance, unharmoniously in (11a) modifies the plurality of events of students striking a note. In (11b), one after the other may only modify plural events (c.f. *Doc stared at you, one after the other)

(11)  a.  Unharmoniously, every student struck a note.  (Schein, 1993: and refs therein)
    b.  Doc stared at every one of his companions, one after the other.

Many proposals capture these facts: Haslinger and Schmitt (2018); Champollion (2010); Kratzer (2000). For simplicity, I will present and adopt the proposal of Champollion (2010). Champollion makes the following assumptions: first, every NP denotes the plurality of all elements in the denotation of its restrictor. While it denotes a plurality, the trace of every NP, after Trace Conversion, carries singular number features. If nothing is done, interpretation cannot proceed because the predicate that every NP composes with is only defined for singular entities.

(12)  a.  \([\text{every NP}] = \bigoplus_{x \in [\text{NP}]} x\)
    b.  

The only fix for this structure is to introduce a distributivity operator down to atoms to mediate between every and the predicate it combines with. In a nutshell, the syntactic requirement of the trace enforces the obligatory distributivity of every.

In the copy-editor sentence, repeated below in (13), another fix to the clash in number features is available. Given that there are now two plural-denoting expressions (every mistake and the 3 copy-editors), the clash may be resolved using a double-star operator (Beck and Sauerland, 2000), instead of a simple distributivity operator. The resulting meaning is the cumulative reading.
(13) a. The 3 copy-editors caught every mistake.

b. [the 3 copy editors] [every mistake] **\( \lambda x. \lambda y. [\text{the copy-editors} = x] \text{ caught } [\text{the mistake} = y] \)**

Although Champollion (2010) does not discuss it, I believe his proposal can be extended to capture ensemble events. Recall that every NP makes available a plural event, as diagnosed by adverbial modification with unharmoniously or one after the other. To capture this, all one needs is to upgrade the distributivity operators that we have used to the event realm. Since this will play no role in the subsequent analysis, I just give the reader the denotation I envision before reverting to event-less denotations:

(14) \( [\text{Dist}] = \lambda p_{evr}. \lambda X_0. \lambda E_0. \forall x < X, \exists e < E, p(e)(x) \land \forall e < E, \exists x < X, p(e)(x) \)

This concludes our discussion of every. The main takeaway is that every is not a distributive quantifier at all levels of LF; at some level, it behaves like a bona fide plural referential expression. In the next section, I will return to same and construct an argument that it takes scope at LF. The account will then proceed as follows: by taking scope, same can access those levels of LF where every acts like a referential plural. same will thus be able to associate with every in the same way that it associates with definite plurals.

### 3. The presuppositions of same and the scope of same

As Charnavel (2011) and Solomon (2009) discuss, same contributes presuppositions, be it in the internal and the external construction. From (15a-b), one infers (15c). This inference of the existence of a book projects through negation and questions; it must then be a presupposition.

(15) a. Angela read the same book as Joshua. (external construction)

Angela didn’t read the same book as Joshua.

Did Angela read the same book as Joshua?

b. Angela and Joshua read the same book. (internal construction)

Angela and Joshua didn’t read the same book.

Did Angela and Joshua read the same book?

c. \( \sim \sim \) Angela and Joshua both read a book.

There also seems to be a presupposition of uniqueness. From (16a-b), one infers (16c).

(16) a. Angela read the same book as Joshua. (external construction)

Angela didn’t read the same book as Joshua.

Did Angela read the same book as Joshua?

b. Angela and Joshua read the same book. (internal construction)

Angela and Joshua didn’t read the same book.

Did Angela and Joshua read the same book?

c. \( \sim \sim \) Neither Angela nor Joshua read more than one book.

As a side note, a minority of speakers do not share the uniqueness inference in (16). In spite of that, I found that these speakers seem to disprefer (17a-b). This is what is expected if they derive the uniqueness inference in (17c). We can make sense of the divergence between speakers and the contrast between (16) and (17) in the following way: in (17), the domain of the uniqueness...
presupposition is clearly defined (i.e. the letters comprised in a word) and less susceptible to contextual restrictions; in (16) however, the domain of the uniqueness presupposition (i.e. the books read by Angela or Joshua) is more likely to be restricted by accommodating speakers.

(17) a. “bar” contains the same letter as “cap”.
    b. “cap” and “bar” contain the same letter.
    c. neither “cap” nor “bar” contain more than one letter.

Summing up, the presence of same triggers existence and, possibly, uniqueness presuppositions. The important observation is that the paraphrase of these inferences contains the main verb of the sentence (i.e. read) and the subjects (i.e. Angela and Joshua), that is to say material coming from outside the DP that hosts same.

(18) Joshua and Angela read the same book.
    Angela read the same book as Joshua.

   a. **Existence**: Joshua and Angela both read a book.
   b. **Uniqueness**: Neither Angela nor Joshua read more than one book

If same were interpreted where it is found in the overt syntax, it would be difficult to wire its meaning compositionally in such a way that the main verb is included in the presupposition it generates.

(19) Angela gave a picture to the same person as Joshua.

This seems to suggest instead that same is not interpreted where it is found (Barker, 2007).

Simplifying Barker (2007) somewhat and temporarily zooming in on external same, we adopt the following structure:

(20)

To give a meaning to this LF that generates the right presupposition, we face a decision point. Our first option is to hard-wire the presupposition of existence and uniqueness into the meaning of same. However, since the is usually assumed to trigger an existence and uniqueness presupposition, there is a second option: we can simply have same feed the \( \lambda P \) abstract with a suitable property \( P \) and let the definite create the existence and uniqueness presupposition that the sentence carries. Both options have their merits\(^3\). I will pursue the latter without justification, since my main point is simply to show that only by scoping can we account for the presuppositions of sentences with same.

\(^3\)On the one hand, French allows one same and this item lacks the existence and uniqueness presuppositions we discuss (Charnavel, 2011), suggesting that it is the that contributes existence and uniqueness, as the second view would have it. On the other hand, even in French, this possibility is limited to internal same in generic contexts,
From the LF in (20), we deduce the type of \( \text{same}_{\text{ext}} \) as Joshua: \(((\text{et})\text{et})\text{et} \), the type of quantifiers over predicates that scope at predicate nodes. Writing a lexical entry for \( \text{same} \) will require some ingenuity but we can take stock on the paraphrase in (21a) and its slightly more logical rendition (21b). This paraphrase has the right existence and uniqueness presupposition (i.e. Angela and Joshua both read just one book), and the right assertion (i.e. the book that Angela read is the book that Joshua read).

\( (21) \)
\begin{align*}
\text{a. Angela read the book that Joshua read} \\
\text{and Joshua read the book that Angela read.}
\end{align*}
\begin{align*}
\text{b. Angela read the book } \lambda x. \text{Joshua read the book } = x \\
\text{and Joshua read the book } \lambda y. \text{Angela read the book } = y
\end{align*}

Given the desired paraphrase and LF, finding the unknown lexical entry of \( \text{same} \) is a matter of abstracting away the lexical material in the paraphrase. Leaving that exercise to the reader, I present the result directly:

\( (22) \) \[ \text{same}_{\text{ext}} = \lambda x. \lambda P((\text{et})et). \lambda y. \lambda P(\lambda z. P(=z)(x)) \land P(\lambda z. P(=z)(y)) \]

The main takeaway of this section is that the presupposition of sentences with \( \text{same} \) can be used to demonstrate scoping. I chose a particular implementation of the scope theory, one that yields the observed presuppositions and applies to the external construction of \( \text{same} \). But our main goal is to derive the internal construction of \( \text{same} \) and specifically, how \( \text{every} \) can associate with \( \text{same} \) in this construction. The next section fulfills that goal: I spell out the reciprocal theory of \( \text{same} \) presented in the introduction, according to which internal \( \text{same} \) is to external \( \text{same} \) what \( \text{enemies} \) is to \( \text{enemy of} \).

4. The reciprocal theory of \( \text{same} \) and how \( \text{same} \) associates with \( \text{every} \)

4.1. Reciprocal alternations

According to the reciprocal theory of \( \text{same} \), internal \( \text{same} \) roughly means “\( \text{same as each other} \)” ; it mirrors a similar alternation found in the relational modifiers that we discussed in the introduction.

\( (23) \)
\begin{align*}
\text{a. Angela is an enemy of Joshua.} \\
\text{b. Joshua and Angela are enemies.}
\end{align*}

I propose to capture the alternation in (23) by means of an operator \( \text{REC}_{(\text{et})\text{et}} \), which reciprocals a relational predicate.

\( (24) \)
\begin{align*}
\text{REC} = \lambda R_{\text{et}}. \lambda X_{\text{et}}. \forall x \neq y \prec X, R(y)(x) \\
\text{a. } [\text{enemy of}] = \lambda y. \lambda x. x \text{ is a enemy of } y \\
\text{b. } [\text{REC enemy}] = \lambda X. \forall x \neq y \prec X, x \text{ is a enemy of } y
\end{align*}

A reciprocalized predicate like \( \text{REC enemy} \) can only be true of pluralities that contain at least two individuals; this is welcome as (25) is not felicitous in out-of-the-blue contexts.
(25) # Angela is an enemy.¹

4.2. Applying \( \text{REC} \) to \textit{same}

We would like to combine \( \text{REC}_{(eet)et} \) with our meaning for external \textit{same}, so that it yields the meaning of “\textit{same as each other}”. This is not possible for type reasons: \( \text{REC} \) is type \((eet)et\) and \textit{same} is type \((et)et\). To overcome this type clash, we would need our reciprocal operator to operate on the first and last argument of \textit{same}, which are type \(e\), but not on the middle one, which is type \((et)et\). This is possible with some standard type-shifting. Specifically, we use the type-shifting in (26a) (an instance of Geach rule used for quantifiers in object position, Hendriks (1987)):

\[
\text{(27) } \left[ \uparrow \text{V}_{(eet)et} \right] = \lambda f_{eet} \cdot \lambda x. \left[ \text{V} \right] (\lambda y. f(y)(x)) \quad \text{(type } (eca)cb) \]

This type-shifter, applied to \( \text{REC} \), raises it to type of \((e(\text{et})et)((\text{et})et)et\). This type achieves what we want: it takes an object like \textit{same}_{ext} and removes its first argument slot (type \(e\)). The resulting meaning for internal \textit{same} is given in (28); in simple words, this denotation gives “\textit{X read the same book}” the meaning of “for all \(x\) different from \(y\) atoms of \(X\), \(x\) read the same book as \(y\)”

\[
\text{(28) } \left[ \text{same}_{int} \right] = \left[ \text{same}_{ext} \uparrow \text{REC} \right] = \lambda P_{(et)et} \cdot \lambda X. \forall x \neq y \prec X, \left[ \text{same}_{ext} \right] (y)(P)(x) \]

We are now in position to specify the meaning of a simple internal construction of \textit{same}, like (29a). The LF is (29b). In this LF, “\(\lambda P. \text{ read the P book}\)” and “Angela and Joshua” -the associate of \textit{same} - are the two arguments of \textit{same}_{int}.

(29) a. Angela and Joshua read the same book.

b.

\[
\text{Angela and Joshua} \quad \text{same}_{int} \quad \text{same}_{ext} \uparrow \text{Rec} \quad \lambda P_{et} \quad \text{read} \quad \text{the} \quad P \quad \text{book} \]

Given our assumptions about the meaning of internal \textit{same}, this LF ultimately derives the paraphrase in (30c), through the critical steps in (30a-b).

¹There is a felicitous reading of that sentence where it means something like Angela is an enemy of us. This is an instance of the relational reading of (23a) with a covert complement.

⁵LF-movement of \( \text{REC} \) could achieve similar results but it would predict that \( \text{REC} \) can take arbitrary scope. The scope of covert reciprocalization seems to be local. For instance, (26a) cannot mean (26b):

(26) a. Poldevia and Plumland want Europeans to be enemies

b. Poldevia want Europeans to be enemies of Plumland and Plumland want Europeans to to be enemies of Poldevia
(30) a. for \( x \) and \( y \) different atoms of \( \text{Angela} \oplus \text{Joshua} \),
\[
[same_{\text{ext}}] (x)(\lambda P. \text{read the } P \text{ book})(y) \text{ is true}
\]
b. \[
[same_{\text{ext}}] (\text{Angela})(\lambda P. \text{read the } P \text{ book})(\text{Joshua}) \text{ is true}
\]
and \[
[same_{\text{ext}}] (\text{Joshua})(\lambda P. \text{read the } P \text{ book})(\text{Angela}) \text{ is true}.
\]
c. Angela read the book that Joshua read
and Joshua read the book that Angela read
and Joshua read the book that Angela read
Angela read the book that Joshua read.

4.3. Association with every

According to our meaning, internal \textit{same} takes its associate as its second argument (i.e. argument \( X \) in (28)). For the same reason that internal \([\text{REC enemy}]\) cannot take singularities as arguments, the denotation of \textit{same} imposes that its associate, the argument \( X \), contains at least two distinct atoms. Thus, internal \textit{same} can only combine with pluralities. This is most welcome, as various singular expressions cannot occur in the internal construction:

\[\text{(31) Out-of-the-blue contexts}\]

\begin{itemize}
  \item a. \# Some poetess read the same book
  \item b. \# Jane read the same book
\end{itemize}

However, our main puzzle is that \textit{same} can associate with singular distributive quantifiers like \textit{every}:

\[\text{(33) Every child read the same book.}\]

This is where our discussion of section 2 plays a role. If we assumed a standard denotation for \textit{every}, there would be no plurality in the structure of (33) that internal \textit{same} could take as an argument. The sentence would be predicted to be as infelicitous as the sentences in (31).

But we have reviewed a number of arguments that \textit{every} does make available a plurality at some level of representation. In the analysis of Champollion (2010) for instance, the structure of (33) is as in (34):

\[\text{(32) I read Madame Bovary. Some poetess read the same book } (\text{as me})\]

Out-of-the-blue contexts rule this parse out and allow us to focus on genuine internal constructions. In that relation, cf. fn. 4.

\[\text{\footnote{We have to be wary of parses where } same \text{ is in its external construction but its \textit{as}-complement is omitted because it is recoverable from context.}}\]
(34)
\[
\begin{aligned}
every \text{child} &= c_1 \oplus \ldots \oplus c_n \\
\text{Dist} \quad \lambda x. \\
\text{the child}_1[\text{sg}] &= x \\
\text{read} \\
\text{the} &\quad \text{same}_{\text{int}} \\
\text{book} &\quad \text{same}_{\text{ext}} \\
\text{Rec}
\end{aligned}
\]

For \textit{same}, it just needs to be in a position where it can take the plurality denoted by \textit{every child} as an argument. Thankfully, we have arguments that \textit{same} must take scope at LF so attaining this position will not be a problem for \textit{same}. The final structure we reach is the following:

(35)
\[
\begin{aligned}
every \text{child} &\quad \text{same}_{\text{int}} \\
\lambda P \\
\text{Dist} \quad \lambda x. \\
\text{the child} &= x \\
\text{read} \\
\text{the} &\quad P \\
\text{book}
\end{aligned}
\]

In this structure, \textit{same} is able to take \textit{every child} as its associate. Given the assumption that the denotation of \textit{every child} is the same as the denotation of \textit{the children}, the composition of this sentence turns out to be no different from the composition of a sentence like “\textit{the children read the same book}”\footnote{As an astute reader may notice, \textit{Dist} is unnecessary in (36) and could have been left out. This is because \textit{Rec} already contains the meaning of distributivity; in the logic of Champollion (2010), any operator that breaks down a plurality into atoms can be used to resolve the conflict between plural \textit{every} and its singular trace and \textit{same}_{\text{int}} can perform the role of \textit{Dist}. I chose to represent \textit{Dist} nonetheless to stay close to the presentation of sec. 2.}:

(36)
\[
\begin{aligned}
[(35)] &= [\text{same}_{\text{int}}] (\lambda P. \text{read the } P \text{ book}) ([\text{every child}]) \\
&= [\text{same}_{\text{int}}] (\lambda P. \text{read the } P \text{ book}) (c_1 \oplus \ldots \oplus c_n) \\
&= \forall x \neq y < c_1 \oplus \ldots \oplus c_n, [\text{same}_{\text{ext}}] (x) (\lambda P. \text{read the } P \text{ book}) (y) \\
&= \forall x \neq y < c_1 \oplus \ldots \oplus c_n, x \text{ read the book that } y \text{ read} \\
&\quad \land y \text{ read the book that } x \text{ read}
\end{aligned}
\]
In short, association of *every* results from the combination of two factors: an underlying plural semantics for singular distributive quantifiers and the availability of scoping with *same*. Both of these factors can be argued for independently from *same*’s association with *every*.

We have solved our initial puzzle. But more questions remain: what in this proposal differentiates *same*, which can associate with *every*, from *neighbors*, which cannot? The next section draws the conclusions of our analysis and shows that this discrepancy is predicted.

5. Typology of relational predicates

Just like *same*, *neighbors* can appear in an external and an internal construction:

(37) a. **External neighbor:**
Angela is a neighbor of Joshua.

   b. **Internal neighbor:**
Angela and Joshua are neighbors.

(38) a. **External same:**
Angela read the same book as Joshua.

   b. **Internal same:**
Angela and Joshua read the same book.

However, *neighbor* does not seem to associate with *every*, contrary to *same*.

(39) a. *Every child is a neighbor.

   b. Every child read the same book.

This is but one of the differences between *neighbor* and *same*. Conspicuously, I used a copular sentence in (37). Predicative sentences reveal a discrepancy. The reading that (40) gets is not what we expect, given the meaning of the corresponding sentence with *same* in (41). Whereas (41) lead us to expect a meaning as in (40b) (obtained from (41) *mutatis mutandis*), we find (40a). With the appropriate contextual set-up, internal *neighbors* can get the missing (40b), as in the reading 1 of (42).

(40) Angela met a neighbor of Joshua

   a. the person Angela met is a neighbor of Joshua

   b. * the person Angela met is a neighbor of the person Joshua met

(41) Angela met the same person as Joshua

   a. the person Angela met is the same as the person Joshua met

Both the lack of association with *every* and the unexpected (40a) reading can be subsumed under the same generalization: contrary to *same*, *neighbor* can only take local associates.

Given the current proposal, this generalization follows from type considerations. While *same* as *DP* has the quantificational type ((et)et)et that allows it to take scope meaningfully, *neighbor* is a simple relational predicate (eet) and as such, can only scope vacuously.

---

8With the appropriate contextual set-up, internal *neighbors* can get the missing (40b), as in the reading 1 of (42).

(42) Angela and Joshua met neighbors

   a. **Reading 1**: the person(s) Angela met is a neighbor of the person(s) Joshua met

   b. **Reading 2**: Angela and Joshua met people who are neighbors of each other.

This exception is only apparent. As discussed in Charnavel (2015), the non-local scope reading (Reading 1) actually arises from a more basic local-scope reading (Reading 2) using contextually provided plural covers. As expected by this approach, the relevant reading disappears in the singular (e.g. *Angela and Joshua met a neighbor*)
More concretely, consider the LF that derives the meaning of (41). If we try to adapt this LF to the case of neighbor, we find that the only acceptable LF type-wise is one where the trace is of the same type as the scoped element. This LF is equivalent to an LF where the scoping has not happened.

(43) a. Angela [same as Joshua] \( \lambda P. \) met the \( P \) person

b. Angela [neighbor of Joshua] \( \lambda P. \) met a \( P \)

\[ \leadsto \text{Angela met a neighbor of Joshua} \]

The same reasoning explains the impossibility of association with every. As we saw, association with every is dependent on same taking the underlying plural denotation of every \( NP \) as an argument; this is achieved by taking scope. While a relational predicate like neighbor can take scope, it will only take scope vacuously and will therefore not be able to take every \( NP \) as an argument.

From a broader perspective, the discussion above draws the line between two types of items: the simple relational predicates (like neighbor) and the quantificational relational predicate (like same). They are superficially similar: both appear in the external construction and, through application of \( \text{REC} \), both will also appear in the internal construction. But two properties set apart the two classes: the possibility of non-local-associates and association with every.

6. Previous literature

In this section, I review different theories of association of every. Despite some advantages over the current proposal, all the theories I will review share the same problem: they cannot distinguish between the two classes of items that the last section reviewed. As such, they over-generate association of every with all relational predicates.

6.1. Plural Dynamic Semantics

Dotlačil (2010) adapts Brasoveanu (2011)’s theory of different to same. This theory relies on an enrichment of a plural dynamic framework. Without going into any details, the core insight is that in the scope of distributive predicates, it is possible for variables to access referents from a different quantificational case.

In concrete terms, using (44) as an example, the scope of every child introduces two referents for each quantificational case: a child at index 1 and a book at index 2. However, through a special primed index 1’, pronouns are able to access referents from other quantificational cases (i.e. the other children, the other books)\(^9\).

(44) Every child 1 \( t_1 \) read the same book\(^2 \) (as \( \text{pro}_{2'} \))

same is then given a meaning akin to identical to. With this meaning in hand and the special indexing made available by distributive quantification, we derive the correct reading of (44) as in (45):

\(^9\)This remains faithful to the spirit of the proposal, not to the letter. In the original proposal, stacks and index offset are used instead of the primed indices.
Every child read the same book as the other books (read by the other boys).

This proposal’s strength is that the meaning of *same* in external and internal constructions is the same, contrary to the current proposal where their meaning is related by REC. This strength turns out to be a weakness; there is nothing in the system to differentiate between *same* and the simple relational predicates like *neighbor*. Thus, with the same indexing this system uses to derive the internal reading of *same*, an internal reading of *neighbor* can be generated:

(46) a. Every boy 1 \( t_1 \) is a neighbor (of \( \text{pro}_1' \)).
   
   b. Reading: every boy is a neighbor of every other boy.


Another theory of association of *every* can be derived from the intriguing proposal of Bumford (2015) for the internal construction of *different*. His analysis is implied to extend to *same*. In a nutshell, the analysis relies on treating *every* as a generalized version of dynamic conjunction. Just as with the previous system, this allows referents from one quantificational case to be accessed by another. Concretely speaking, (47a) is read as (47b), where each successive update introduces a referent (indicated by superscripts) for the next update to pick up (subscripts). (In my presentation, the first update - *child 1 read the same book* - is distinguished from the other updates in not having a complement. I ask the reader to disregard this glitch in the sequel.)

(47) a. Every child read the same book.
   
   b. Child 1 read the same book\(^1\).
      
      Child 2 read the same book\(^2\) (as \( \text{pro}_1 \))
      
      Child 3 read the same book\(^3\) (as \( \text{pro}_2 \))
      
      ...

Contrary to the previous framework, the proposed enrichment of the meaning of *every* is motivated by independent evidence (pair-list readings, internal readings of comparatives). Thus, this system looks more appealing. However, it suffers from exactly the same flaw. *same* is not distinguished from any other relational modifier; the same LF that generates an internal reading of *same* can deliver an internal reading of *neighbor*:

(48) a. Every child visited a neighboring town.
   
   b. Child 1 visited a neighboring town\(^1\).
      
      Child 2 visited a neighboring \( \text{town}^2 \) (pro\(_1\))
      
      Child 3 visited a neighboring \( \text{town}^3 \) (pro\(_2\))
      
      ...


Charnavel (2015) treats *same* as integrating a covert pronominal anaphor OTHER. Thus (49) has the structure of (49a), which in turn reads as (49b).

(49) Every boy read the same book.
   
   a. Every boy \( \lambda x. \) read the same book as \( \text{OTHER}(x, y) \)
      
      where \( y \) are all the boys.
b. Every boy read the same book as the other boy.

This approach looks similar to the current one, as it includes an element of reciprocity. Without the difference between scoping elements like *same* and non-scoping elements like *enemy*, the account will however predict both of those words to appear in the internal construction. Nothing is said to prevent the Other anaphor from being used in other constructions like *enemy*.

This approach has another more straightforward problem. It predicts that the scope of *same* and the scope of *every* may be dissociated. In the current account, *same* has to scope to *every* to associate with its underlying plural denotation.

The following contrast illustrates that the latter prediction is correct, not the former. Speakers judge that (50a) can only receive the De Re reading in (51a), not the reading in (51b). The proposed paraphrase in (50b) can receive both readings.

(50) a. Every boy wants PRO to wear the same shirt.
   b. Every boy wants to wear the same shirt as the others.

(51) a. De Re: each boy came to me and said: "I want to wear the orange shirt"
   ✓ (50a), (50b)
   b. De Dicto: each boy came to me and said: "I want to be wearing the same shirt as the others."
   ✓ (50b), * (50a)

The explanation on the proposal that I defend is straightforward: because *want* is control, *every* may not scope under *want*. To associate with *every*, *same* must scope just below *every*. It must therefore outscope *want*, yielding a De Re reading of *every*.

The missing De Dicto reading may appear with internal *same*, if PRO can serve as a local associate of *same*. This happens when we use the definite plural *the boys*, instead of the singular *every boy*. In this case, the definite binds PRO in the plural. PRO, being interpreted as a plural, can serve as the associate of *same*.

(52) a. The boys want PRO_pl to wear the same shirt.
   b. De Dicto: the boys came to me and said: "we want to wear the same shirt."}

7. Conclusion and open ends

In this article, I have tackled the challenge raised by the internal construction of *every* to the naive reciprocal theory of *same*. I have provided evidence that *same* takes scope, building on work by Solomon (2009) and Charnavel (2011). I have reviewed evidence that *every* makes available some form of plurality at some level of representation. These two conclusions together explain how *every* comes to license sameRec which must ordinarily combine with a plurality.

10 Depending on how you set the dynamic semantics, the other accounts may face the same issue.
11 This reading is not only De Dicto; it is also interpreted as a collective wish. If the boys were interpreted distributively, PRO would refer to a singularity, barring association with *same*. 

Keny Chatain
The general idea of the account has some room to maneuver. One could ask whether other theories of *every* that capture its plural behaviors can be meshed with the reciprocal theory of *same*. For instance, in Kratzer (2000), *every* does not make available a plurality of individuals but a plurality of events. To accommodate this event denotation, an adaptation of the current proposal would need to make *same* operate on events rather than individuals. Incidentally, the fact that *same* is sensitive to events has been argued for by Hardt and Mikkelsen (2015).

Another extension concerns the nature of the existence and uniqueness presupposition; this account assumed it to stem from the definite article. Since the main point was to show that any account of this presupposition would require scoping, I did not provide much motivation for this option. It might even be problematic, as it seems to predict the possibility of *a same book* (but see Charnavel (2011) on French).

More promising is the approach of Sun (2019), where the presuppositions stem from *same* itself and the use of the definite article is enforced by *Maximize Presupposition!*. This approach happens to embrace both the reciprocal theory of *same* and the scopal theory of *same*. As such, I believe that it could be fruitfully compounded with the current approach.

References


Expected value of conditionals and expected utility: a probabilistic account of conditional evaluative constructions

WooJin CHUNG — New York University

Abstract. This paper develops a probabilistic account of the Korean conditional evaluative construction that conveys obligation, which is expressed in terms of a conditional and an evaluative predicate. Assuming that conditionals denote the degree of support for the consequent given the antecedent and that evaluative predicates are measure functions that return the utility value of a given world argument, the compositional semantics of the construction at hand gives rise to an expected utility-based semantics of deontic modality. I point out its relevance to decision theory and further offer a principled solution the problem of supererogation.

Keywords: modality, conditionals, expected utility, supererogation.

1. Introduction

This paper proposes that the Korean construction that is used to convey obligation (cf. English must, should, and ought) suggests to maximize expected utility, as proposed in the literature on decision theory (Gibbard and Harper, 1978; Lewis, 1981). Korean does not make use of an auxiliary or a verb to express deontic concepts. Rather, such concepts are expressed in terms of a conditional and an evaluative predicate. For example, English ‘ought p’ effectively translates to ‘only if p, good’ in Korean, as exemplified below:

(1) John-un Aleppo-ey ka-ya toy-n-ta.
John-top Aleppo-to go-only.if good-pres-decl.
‘John ought to go to Aleppo.’
‘(Lit.) Only if John (were to) go to Aleppo, good.’

Adopting Kaufmann’s (2017) terminology for similar constructions in Japanese, I will refer to these constructions as conditional evaluative constructions. Assuming a weak version of semantic uniformity, Chung (2019) hypothesizes that the above conditional evaluative construction is a transparent version of the corresponding weak modal necessity expressions in other languages. Chung provides a compositional account of the construction based on Kratzer’s (1981b) premise semantics and further claims that it offers a principled solution to the Professor Procrastinate puzzle (Jackson and Pargetter, 1986), fully explaining the presence of the order effect pointed out by von Fintel (2012).

While in agreement with Chung (2019) that Korean conditional evaluative constructions can and should receive a compositional account, this paper entertains an entirely different set of assumptions regarding the semantics of conditionals and evaluative predicates: (i) conditionals denote the degree of support for the consequent, given the antecedent and certain relevant facts of the world of evaluation, and (ii) the evaluative predicate toy ‘oooon’ is a function of worlds that returns the utility value of the world argument. The resulting semantics suggests that the

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2Korean conditionals do no require a subjunctive morphology to express counterfactuality. It is possible that (1) receives a counterfactual reading or an indicative reading, depending on the context.
expected utility of the prejacent is significantly higher than that of its alternatives. One notable characteristic of the Korean conditional evaluative construction is that it not only compares the expected utility of the prejacent and its alternatives but also takes into consideration the relative degree to which they differ. I suggest that this is the key to resolving the problem of supererogation—the problem of whether a theory of deontic modality based on (comparative) goodness can distinguish duties from supererogatory acts.

In what follows, I will first introduce expected value-based accounts of conditionals. I then offer a measure function analysis of the Korean evaluative predicate 'goo'. I show that a compositional analysis of the Korean conditional evaluative construction in (1) derives an expected utility-based semantics. I will focus on the counterfactual interpretation of the construction, while remaining agnostic on whether an indicative reading is available. I would like to note that the counterfactual reading of the construction relates to causal decision theory, whereas the indicative reading of it makes connection to evidential decision theory.

In the latter half of the paper, I will turn to the problem of supererogation which poses a non-trivial issue for existing theories of deontic modality. I show that the proposed semantics provides room for distinguishing duties from supererogatory acts, while maintaining the cherished relation between ought and the conception of goodness.

2. Expected valued-based accounts of conditionals

There are at least two lines of research that hypothesize that the interpretation of a conditional involves expected value calculation. In computer science, Pearl (2000, 2011, 2013) developed a theory of conditionals that involves manipulation of causal graphs, which are used to determine which propositions to additionally condition on in calculating the conditional probability of the consequent given the antecedent. In linguistics and philosophy, there have been attempts to define the assertability or value of a conditional in terms of its corresponding conditional probability (Jeffrey, 1964; Adams, 1965; Stalnaker, 1970; Lewis, 1976; Jeffrey and Edgington, 1991; Kaufmann, 2005; Douven, 2008). In its simplest incarnation, the assertability/value of a conditional is defined as the conditional probability of the consequent given the antecedent. Following Kaufmann (2005), I will additionally incorporate Pearl’s (2000) notion of causality which allows the theory to properly handle counterfactuals and embedded conditionals.

I assume that the value of a proposition-denoting expression is either 0 (false) or 1 (true). On the other hand, conditionals denote the degree of support for the consequent, given (i) the antecedent and (ii) facts that are causally independent of the antecedent. Causal independence is interpreted with respect to (i) Φ: a set of causally relevant propositions singled out from the set of all propositions and (ii) <: a strict partial order which informally read as “affects the expectation of”. The pair ⟨Φ, <⟩ uniquely determines a causal graph that characterizes the

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3There is no consensus on whether the value of a conditional is defined in terms of conditional probability. For instance, Stalnaker’s (1970) objective was to develop a theory of conditionals that validates the hypothesis the probability of a conditional is its corresponding conditional probability.

4Kaufmann’s original analysis takes a time-related parameter into account. Specifically, the evaluation procedure additionally conditions on facts that are settled at the time of evaluation. To my understanding, the settled facts only affect the probability distribution over worlds, and omitting this parameter amounts to assuming that the probability distribution remains constant throughout time. For simplicity, I will omit this parameter and focus on how the compositional analysis of the Korean conditional evaluative construction connects to the decision theory literature.
causes and effects.

(2) Causal independence (Kaufmann, 2005)

Given a causal structure \( \langle \Phi, \prec \rangle \), for all \( p, p' \in \Phi \): \( p' \) is causally independent of \( p \) iff \( p \prec p' \).

The degree of support is defined in terms of expected value: it is the expected value of the consequent given the antecedent and causally independent facts, as fleshed out in (3). By the definition of expected value, if the consequent is a proposition-denoting expression (i.e., its value is either 0 or 1), then the value of a conditional is a real number within the interval \([0, 1]\). A value close to 1 represents a high degree of support, whereas a value close to 0 indicates a low degree of support. Due to their range, conditionals with a proposition-denoting consequent can be interpreted as the conditional probability of the consequent given the antecedent.

(3) Expected value-based analysis of conditionals (cf. Kaufmann, 2005)

\[
\llbracket p \rightarrow q \rrbracket = \mathbb{E}[q \mid p, c_1, \ldots, c_i] = \sum_j q(w_j) \ast Pr(\{w_j \mid p, c_1, \ldots, c_i\})
\]

where \( c_1, \ldots, c_i \) are causally independent facts of \( p \) and \( w_j \in \cap\{p, c_1, \ldots, c_i\} \)

While I have shown that probability measures can be obtained as a special case of expected value calculation (i.e., when the consequent of a conditional is a proposition-denoting expression), the analysis in (3) does not require that the consequent of a conditional is proposition-denoting. In the following section, I will take advantage of this underspecification and claim that conditional evaluative constructions do not denote a probability measure but rather an expected utility one.

3. Deriving an expected utility-based semantics from scratch

As for the analysis of the evaluative predicate ‘toy ‘good’, I propose that it is a measure function that takes a world and returns the degree of goodness (i.e., utility value) of the world argument.\(^5\)

(4) A measure function analysis of ‘toy ‘good’\(^6\)

\[
\llbracket \text{good} \rrbracket = \lambda w'. \mu_{\text{good}}(w'),
\]

where \( \mu_{\text{good}}(w') \) returns the utility value of \( w' \)

Recall that Korean utilizes an -(e)ya ‘only if’ conditional to convey obligation. I will first leave out the contribution of the only component and show how ‘if \( p \), then \( \text{good} \)’ is interpreted. The formula in (5) is derived from (3) by simply replacing the consequent \( q \) with the evaluative predicate ‘toy ‘good’. The upshot is that the formula calculates the expected value of the measure function \( \mu_{\text{toy}} \) conditioned on the antecedent \( p \) and causally independent facts. In other words, the conditional denotes the expected utility of the counterfactual \( p \)-worlds.

(5) \[
\llbracket p \rightarrow \text{good} \rrbracket = \mathbb{E}[\mu_{\text{good}} \mid p, c_1, \ldots, c_i] = \sum_j \mu_{\text{good}}(w_j) \ast Pr(\{w_j \mid p, c_1, \ldots, c_i\}),
\]

where \( c_1, \ldots, c_i \) are causally independent facts of \( p \) and \( w_j \in \cap\{p, c_1, \ldots, c_i\} \)

\(^5\)This is reminiscent of how Lassiter (2017) predicates goodness of worlds, although he eventually lifts the domain of assessment from worlds to propositions. What will be shown is that a probabilistic analysis of the Korean conditional evaluative construction replicates Lassiter’s lifting operation due to the conditional semantics.

\(^6\)The analysis presented as it is implies that values are not world-dependent and is likely a oversimplification of the matters. But since the main objective of this paper is to highlight the connection between Korean conditional evaluative constructions and decision theory, I will simplify the matters as long as it does not affect the main argument.
I will assume that a thresholding operation (Lassiter, 2017) is performed on (5) to map the degree representation to a bivalent representation. Specifically, if the expected utility of the counterfactual \( p \)-worlds is higher than the contextually determined threshold \( \theta_{toy} \), we can map it to true (1). If the expected utility is less than or equal to \( \theta_{toy} \), we map it to false (0). So if we assume that the thresholding operation is invoked by default, (5) conveys that the counterfactual \( p \)-worlds have a sufficiently high expected utility.

As for the threshold \( \theta_{toy} \), I assume along with Lassiter (2017) that setting its value is guided by the contextually salient set of alternatives. Specifically, the guideline is the expected utility of the union of the alternatives. So for instance, if the contextually salient set of alternatives is \{\( p \), \( \neg p \)\}, the corresponding baseline is the expected utility of the union of the counterfactual \( p \)-worlds and the counterfactual \( \neg p \)-worlds. The intuition behind this is that \textit{good} conveys ‘(somewhat) better than average’, and it is also in accordance with how other relatives adjectives (\textit{tall}, \textit{long}, \textit{happy}) behave.

A complete analysis of Korean obligation can be derived from the above conditional semantics by exhaustifying it. As for the semantics of the exhaustification operator, I will posit a simplified variant of Rooth (1992), such that the exhaustification operator takes a proposition and negates each of the alternatives. Applying the exhaustification operator on top of (5) yields the semantics in (6). What is additionally conveyed due to exhaustification is that for every alternative \( r \) to \( p \), \([r \rightarrow \text{good}]^n\) returns a value that is less than or equal to the threshold \( \theta_{toy} \) (i.e., not sufficiently high). The expected utility of the counterfactual \( r \)-worlds is not sufficiently high, whereas that of the counterfactual \( p \)-worlds is sufficiently high. An intuitive way of rephrasing this is to say that the expected utility of the counterfactual \( p \)-worlds stands out among the alternatives.

(6) An expected value-based analysis of Korean obligation

\[
\begin{align*}
\text{only} \left( \left[ \left[ p \rightarrow \text{good} \right] \right] \right) \\
= \mathbb{E}[\mu_{\text{good}} \mid p, c_1, \ldots, c_i] > \theta_{toy} \land \forall r \in \text{Alt}(p) \text{ s.t. } r \neq p : \mathbb{E}[\mu_{\text{good}} \mid r, c_1, \ldots, c_i] \leq \theta_{toy}, \\
\text{where } c_1, \ldots, c_i \text{ are causally independent facts of } p
\end{align*}
\]

There is an interesting connection between the above semantics and causal decision theory. Causal decision theory partitions the set of worlds into act-independent states \( s_i \) and calculates the expected utility of an act \( p \) by summing over the product of (i) the probability that \( s_i \) would obtain if \( p \) were the case (i.e., \( Pr(p \rightarrow s_i) \)) and (ii) the utility value of the outcome jointly determined by the act \( p \) and the state \( s_i \) (i.e., \( o[p,s_i] \)). This amounts to calculating the expected utility of the counterfactual \( p \)-worlds.

(7) Causal expected utility of \( p \) (Gibbard and Harper, 1978)

\[
\text{EU}_{\text{CDT}}(p) = \Sigma_i Pr(p \rightarrow s_i) \ast u(o[p,s_i])
\]

Causal decision theory compares the causal expected utility of each available act to determine the optimal choice. Since (6) conveys that the counterfactual prejacent-worlds have the best expected utility (\( \because \) only the counterfactual \( p \)-worlds have the expected utility higher than the threshold), it makes the same recommendation.

There is one important difference, however, due to the thresholding operation. The proposed

\footnote{Although debatable, I will assume along with Gibbard and Harper (1978) that acts and outcomes are represented as propositions.}
semantics requires that the expected utility of the counterfactual prejacent-worlds is considerably higher than that of the counterfactual alternative-to-the-prejacent-worlds. If one of the alternatives has a slightly lower expected utility than the prejacent but the expected utility is still higher than the threshold $\theta_{toy}$, we would not be able to conclude that the prejacent is obligatory. On the other hand, causal decision theory does not impose this requirement. In the following sections, I show that this additional requirement is the key to resolving the problem of supererogation.

4. Supererogation and the good-ought tie-up

Supererogation refers to the class of acts that go “beyond the call of duty” (Heyd, 1982). Such acts are not obligatory, although it would be good to bring them about. Although there is no clear consensus as to what technically qualifies as supererogatory, informally, small acts of favor, acts of heroism, self-sacrifice, politeness, and consideration are mentioned as typical instances of supererogation. Among ethical theorists, discussions on supererogation have centered around what has been called the paradox of supererogation: given that supererogatory acts are morally good to bring about, why aren’t they required? Some deny the existence of supererogation and dictate that whatever is good is required (Moore, 1948; New, 1974; Feldman, 1986; Pybus, 1982; Crisp, 2013). Others affirm the existence and characterize it in terms of the intrinsic value of beneficent intentions or altruism (Heyd, 1982; Zimmerman, 1996), or in terms of the limited cost-effectiveness of sanctioning the agent who has failed to fulfill a given duty (Richards, 1971; Cohen, 2015).

While much attention has been paid to the problem of supererogation in metaethics, it has received little interest among linguists. However, the potential impact it has on linguistic theories of deontic modality is not negligible. The following scenario is originally due to Lassiter (2017), slightly modified to better manifest the problem:

Suppose that John ought to visit an ailing friend, say Mary. Suppose also that it would be even better, when John visits, to cook Mary dinner. Does it then follow that John ought to visit and cook Mary dinner? No doubt in some cases he should, but this is not a semantic fact: it is clearly possible that the following could hold as well.

(8) There are many things John can do for Mary. He can make a visit, cook dinner, and so on. In view of Mary’s well-being...
   a. John should/ought to visit Mary.
   b. Visiting and cooking dinner is better than visiting and not cooking dinner.
   c. However, cooking dinner is strictly optional: it’s not the case that you should/ought to visit and cook dinner.

In the above scenario, cooking for Mary is beyond what is required, and in this sense it is supererogatory. We do not want to validate an inference from ‘ought visit’ to ‘ought visit \& cook’. While previous discussions on supererogation focused on the interpretation of ought, we can also observe the same invalid inference pattern for has to: even though John has to visit Mary, it does not necessarily follow that John has to visit Mary and cook for her.

Lassiter (2017) points out that the above scenario poses a non-trivial challenge to Lassiter’s (2011) account of ought based on expected utility (EU), which is briefly summarized in (9).
The formula states that ‘ought $p$’ is true if and only if the expected utility of $p$ is greater than the threshold value $\theta_{\text{ought}}$ determined by the lexical semantics of $ought$ in interaction with the context.

(9) Lassiter’s (2011) EU-based account

$$\square \text{ought} \equiv \lambda p. \text{EU}(p) > \theta_{\text{ought}}$$

Given the above definition, ‘ought visit’ asserts that the expected utility of visit is greater than $\theta_{\text{ought}}$. The problem is that the expected utility of visit $\land$ cook is always greater than or equal to that of visit in the given scenario. The proof goes as follows: Since it is assumed that (8b) is true, the expected utility of visit $\land$ cook is greater than that of visit $\land \neg$cook. And by definition, the expected utility of a disjunction falls between the expected utility of the two disjuncts, so the expected utility of visit, which is a disjunction of visit $\land$ cook and visit $\land \neg$cook, is less than the expected utility of visit $\land$ cook. It then follows that the expected utility of visit $\land$ cook is greater than $\theta_{\text{ought}}$, and it is predicted that ‘ought visit $\land$ cook’ is true.

(10) $$\square \text{ought visit} \equiv \text{EU}(\text{visit}) > \theta_{\text{ought}}$$

(11) $$\text{EU}(\text{visit} \land \text{cook}) > \text{EU}((\text{visit} \land \text{cook}) \cup (\text{visit} \land \neg \text{cook}))$$

(12) $$\text{EU}(\text{visit} \land \text{cook}) > \text{EU}(\text{visit} \land \neg \text{cook})$$

Due to the above issue, Lassiter (2017) takes a weaker stance and does not offer a truth condition of ought. Instead, he lists necessary conditions for an ought statement to be true. One of them is Sloman’s principle which states that if ‘ought $p$’ is true, then the expected utility of $p$ is greater than the expected utility of each of its alternatives. This condition cannot be a sufficient condition though, because had it been the case, we would be back to the analysis in (9) and would suffer from the problematic scenario.

(13) Sloman’s principle

$$\text{ought } p \rightarrow \text{EU}(p) > [\forall q \in \text{Alt}(p) : q \neq p \rightarrow \text{EU}(p) > \text{EU}(q)]$$

The standard account of deontic modality due to Kratzer (1981a) also validates the problematic inference under certain realistic assumptions. It is standardly assumed, under the simplifying Limit Assumption (Lewis, 1973), that necessity modals assert that the modal prejacent is necessarily true in the best worlds. In the case of deontic modals, the best worlds are identified by two conversational backgrounds supplied by the context, namely circumstantial modal base $f$ and deontic ordering source $g$. The former takes a world of evaluation and returns the set of propositions that correspond to the relevant circumstances for the interpretation of the modal, and the latter takes a world of evaluation and returns the set of propositions that correspond to the ideals. Intersecting the former (i.e., $\cap f(w)$) yields the set of relevant worlds, and the deontic ordering source is utilized to select the deontically best worlds within the set. Specifically, $g(w)$ induces an ordering $\leq_g(w)$ (informally read as ‘at least as good as’) such that for any two worlds $u$ and $v$, $u \leq_g(w) v$ if and only if the set of propositions in $g(w)$ that are true in $u$ is a subset of the set of propositions in $g(w)$ that are true in $v$. The set of deontically best worlds consists of

---

8I will not make a distinction between strong necessity modals (e.g., must, have to) and weak necessity modals (e.g., should, ought), since the problem applies to both classes. See von Fintel and Iatridou (2008) and Silk (2018) for relevant discussions.
circumstantially relevant worlds that are at least as good as any of the circumstantially relevant worlds.

(14) Ordering \( \leq_{g(w)} \) with respect to \( g(w) \)
For all \( u, v \in W \), \( u \leq_{g(w)} v \)
iff \( \{ p : p \in g(w) \land p(v) = 1 \} \subseteq \{ p : p \in g(w) \land p(u) = 1 \} \)

Due to the fact that the standard account evaluates the truth of the prejacent only in the deontically best worlds, the presented scenario would be problematic if such worlds exclusively consisted of \( \text{visit} \land \text{cook} \)-worlds. Given the assumption that ‘ought \text{visit}’ is true, the deontically best worlds are \( \text{visit} \)-worlds. Moreover, since we are assuming that \( \text{visit} \land \text{cook} \) is better than \( \text{visit} \land \neg \text{cook} \), any \( \text{visit} \land \neg \text{cook} \) would be outranked by a \( \text{visit} \land \text{cook} \)-world that minimally differs in the truth of \( \text{cook} \). Consequently, the deontically best worlds are all \( \text{visit} \land \text{cook} \)-worlds, and it is predicted that ‘ought \( \text{visit} \land \text{cook} \)’ is true.

The formal argumentation can be given in two steps: (i) show that \( \text{cook} \) is a member of the deontic ordering source \( g(w) \) if visiting and cooking is better than visiting and not cooking, and (ii) show that the deontically best worlds are all \( \text{visit} \land \text{cook} \)-worlds, given the assumption ‘ought \( \text{cook} \)’ is true. The first argument requires the assumption that \( \text{cook} \) does not contradict any of the ideals. While this is not entirely innocuous, I find it to be a plausible circumstance. Moreover, we would want to invalidate the problematic inference in such a circumstance. Now, suppose that \( \text{cook} \notin g(w) \). By the definition of comparative possibility given in (i), for ‘\( \text{visit} \land \text{cook} \)’ to be better than ‘\( \text{visit} \land \neg \text{cook} \)’, there needs to be a \( \text{visit} \land \text{cook} \)-world \( u \in \cap f(w) \) such that no \( \text{visit} \land \neg \text{cook} \)-world \( v \in \cap f(w) \) is at least as good as \( u \). But this cannot be the case because given the assumption that \( \text{cook} \notin d(w) \), a world that minimally differs from \( u \) in that \( \text{cook} \) is false is at least as good as \( u \). This leads to a contradiction, and it is concluded that \( \text{cook} \in g(w) \).

(15) Comparative possibility (Kratzer, 1981a)

A proposition \( p \) is more possible than a proposition \( q \) in a world \( w \) in view of a modal base \( f \) and an ordering source \( g \) if, and only if, the following conditions are satisfied:
\[
\begin{align*}
a. \quad & \forall u \in \cap f(w) : [u \in q \rightarrow \exists v \in \cap f(w) : v \leq_{g(w)} u \land v \in p] \\
b. \quad & \exists u \in \cap f(w) : [u \in p \land \neg \exists v \in \cap f(w) : [v \in q \land v \leq_{g(w)} u]]
\end{align*}
\]

For the proof of the second point, suppose that there exists a \( \text{visit} \land \neg \text{cook} \)-world, \( u \), which is deontically best. A world \( v \) that minimally differs from \( u \) with respect to the truth of \( \text{cook} \) is strictly better than \( u \) (i.e., \( v \leq_{g(w)} u \) and \( u \notin g(w) \)), given that \( \text{cook} \in g(w) \). By the definition of the best worlds, any two best worlds need to be equally good or should be incomparable. Therefore, \( u \) is not a deontically best world, and the set of deontically best worlds exclusively consists of \( \text{visit} \land \neg \text{cook} \)-worlds.

One possible objection in favor of the standard account is to say that (8a) and (8b) make use of different ordering sources. What prevents me from further developing this line of thought at the moment is that I have no explanation for why the ordering source shifts so easily even in the presence of an explicit ordering source (i.e., the explicit reference to what John can do for Mary, and prefixing each sentence with ‘in view of Mary’s well-being’). It would be an interesting and outstanding challenge to pinpoint the source of the shift, and to delineate the shifting process. In this paper, I will focus on how the probabilistic account of the Korean
conditional evaluative construction invalidates the problematic inference.

5. Case study

What I intend to show in this section is that certain value assignments can render ‘John ought to visit Mary’ true but falsify ‘John ought to visit Mary and cook dinner’ at the same time. Note that the issue in Lassiter’s (2011) semantics was that no value assignment allows this possibility in the scenario depicted in section 4, and that the standard account suffers as well due to the fact that visiting and cooking is better than visiting and not cooking.

Let us begin with assessing ‘ought visit’. The contextually salient set of alternatives is given as \{ visit, \neg visit \}. One possible set of value assignments for the two alternatives is provided in (16). The baseline for the threshold \( \theta_{toy} \) has been computed under the assumption that the two alternatives are equally probable, but a minor shift in the threshold value would not make a difference. Because the expected utility of the counterfactual visit-worlds is greater than \( \theta_{toy} \) and that of the counterfactual \neg visit-worlds is less than or equal to \( \theta_{toy} \), ‘ought visit’ is predicted as true.

(16) Possible value assignments:
\[
\begin{align*}
\mathbb{E}[\mu_{good} | visit, c_1, ..., c_i] &= 50 \\
\mathbb{E}[\mu_{good} | \neg visit, c_1, ..., c_i] &= 0 \\
\theta_{toy} &= \mathbb{E}[\mu_{good} | visit \cup \neg visit, c_1, ..., c_i] = 25
\end{align*}
\]

As for ‘ought visit \wedge cook’, I will assume that the contextually salient set of alternatives is \{ visit \wedge cook, visit \wedge \neg cook, \neg visit \}. Given that cooking is only a preference, I will assume that cook makes less contribution to the expected utility than visit. Assuming that cooking and not cooking are equally probable, a possible set of value assignments that is consistent with the one in (16) is given in (18), and ‘ought visit \wedge cook’ receives the analysis in (19) accordingly.

(18) Possible value assignments:
\[
\begin{align*}
\mathbb{E}[\mu_{good} | visit \wedge cook, c_1, ..., c_i] &= 60 \\
\mathbb{E}[\mu_{good} | visit \wedge \neg cook, c_1, ..., c_i] &= 40 \\
\mathbb{E}[\mu_{good} | \neg visit, c_1, ..., c_i] &= 0 \\
\theta_{toy} &= \mathbb{E}[\mu_{good} | (visit \wedge cook) \cup (visit \wedge \neg cook) \cup (\neg visit), c_1, ..., c_i] = 25
\end{align*}
\]

(19) \[
\begin{align*}
\text{\textbf{ought visit \wedge cook}} &\quad = \mathbb{E}[\mu_{good} | visit \wedge cook, c_1, ..., c_i] > \theta_{toy} \land \mathbb{E}[\mu_{good} | visit \wedge \neg cook, c_1, ..., c_i] \leq \theta_{toy} \\
&\quad \land \mathbb{E}[\mu_{good} | \neg visit, c_1, ..., c_i] \leq \theta_{toy}
\end{align*}
\]

In this configuration, ‘ought visit \wedge cook’ is false. Although the expected utility of the counterfactual visit \wedge cook-worlds is greater than the threshold, the expected utility of the counterfactual visit \wedge \neg cook-worlds is also greater than the threshold. Given the proposal, the truth of ‘ought visit \wedge cook’ requires that the the expected utility of the counterfactual visit \wedge \neg cook-worlds is less than or equal to the threshold, but this is not the case.
6. Conclusion

A probabilistic account of Korean deontic modality highlights an interesting connection between natural language and decision theory. Furthermore, the semantics adds a proviso that the expected utility of the prejacent-worlds is significantly higher than that of the alternatives. It allows one to distinguish duties from supererogatory acts, thus illustrating the usefulness of expected utility in studying normative discourse. Conversely, it also manifests the usefulness of natural language semantics for decision theory. It makes suggestions as to how the expected utilities should be compared for rational decision making.

As a concluding remark, I would like to emphasize that the proposed account does not invalidate the problematic inference from ‘ought \text{visit}' to ‘ought \text{visit} \land \text{cook}' no matter what. For instance, if cooking contributed to the expected utility as much as visiting, the analysis would predict that ‘ought \text{visit} \land \text{cook}' is in fact true. This is not a weakness, but rather a preferred property. If cooking is so important, we are inclined to conclude that bringing it about is also required. We do want the semantics to validate the inference under such circumstances, but at the same time, the semantics should be flexible enough to invalidate it if cooking is indeed supererogatory.

References


Swarms and degrees – two experiments on Slavic swarm constructions

Mojmír DOČEKAL — Masaryk University
Iveta ŠAFRATOVÁ — Masaryk University, Georg-August-Universität Göttingen

Abstract. The paper discusses the results of two experiments on Czech swarm-constructions. The results are interpreted in the degree approach to swarms (Hoeksema, 2009). Furthermore, some polarity constraints on swarms are clarified and described as a special case of degree positive polarity items.

Keywords: swarm-constructions, PPIs, experiments, degree semantics, Czech.

1. Introduction

Swarm-construction belongs to the family of argument alternations like active-passive or spray-load alternations, but compared to the two previously mentioned, swarms attracted a bit less attention from formal linguists (see especially Dowty 2000, 2001; Hoeksema 2009, 2018). We will summarize some of the most influential approaches to swarms in section 2, but let us first illustrate the alternation via data patterns. The most widely used predicate (both in the literature and language material) of the alternation is in (1) (from Hoeksema, 2009) and gave name to the whole construction. The variant in (1a) is usually considered as a baseline: the subject of the activity (in many cases repeated movement) is located as a figure in a ground syntactically realized as an object PP. We will call this type A-construction (following the similar naming convention as A-Subject from Dowty 2000). The semantically more loaded (1b) (L-construction) has the ground in the subject position, and the entities executing the activity are syntactically realized as with-headed PP. There are many intriguing semantic and pragmatic differences between A- and L- constructions (on top of the mentioned syntactic alternation) but let us now focus on one which will be central for our paper: in the L-construction the ground is totally affected by the activity which seems not to be the case in the A-construction. We will formalize this intuitive difference in a scalar framework, essentially following Hoeksema (2009).

(1) a. Termites are swarming in my kitchen.  [A-construction]
    b. My kitchen is swarming with termites.  [L-construction]

Swarm alternations appear either in A- vs. L-construction demonstrated above, or they can be found in the third sub-type, demonstrated with a German example (from Hoeksema, 2009: ex.6) and Czech data in (2c) and (3c). We will call the third sub-type es-construction as in German (and some other Germanic languages where it appears) the subject position is filled with the expletive es.

(2) a. Ameisen wimmeln in der Küche.
    Ants swarm in the kitchen

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In this paper, we discuss two experiments (on Czech data), which (i) show that the intuition of total-affectedness derives from the scalar properties of the L-construction; (ii) probe into the nature and mechanisms behind the polarity constraints on the L-construction.

2. Two approaches to swarms

In this section, we discuss two approaches to swarms that are dominant in formal linguistic literature. Historically first is Dowty’s dynamic texture hypothesis (Dowty, 2000), which is summarized in section 2.1, Hoeksema’s scalar approach is introduced in section 2.2. In the last part of this section (2.3), we summarize Solt (2018), one of the most successful attempts to deal with scalar polarity constraints. The scalar nature as a source of positive polarity behavior was previously considered improbable (see especially Szabolcsi 2004), but nowadays, it seems more accepted that scalarity plays a role in the licensing of some PPIs and some NPIs though not all (Rullmann, 1996; Hoeksema, 2018).

2.1. Dynamic texture hypothesis

Let’s first start with the “dynamic texture hypothesis” as Dowty himself names it. In the current section, we will summarize the main points of this approach, skipping over intriguing details which are not central for our paper.

As for the empirical coverage, Dowty (2000) lists the following 5 classes of swarms:

1) small local movements (repeated): crawl, drip, buble, dance, foam, rumble, pulsate, …

2) animal (and other) sounds (repetitive): hum, buzz, whistle, resonate, echo, …

3) kinds of light emission: beam, blaze, flame, glow, glitter, …

4) smells and tastes: smell, taste, reek, …

5) degree of occupancy/abundance: brim, teem, be rampant, …

He furthermore notices that all the verbs in the five classes are atelic activities but not vice versa:
if an activity does not describe repeated movement/sound/... it cannot undergo the swarm alternation; compare ungrammatical attempt to make an L-construction from a predicate denoting directly oriented motion like *The road marched with soldiers. Some morphological support for Dowty’s claim can be found in Slavic languages where swarm-predicates are nearly without exception imperfective pluractional verbs (the only exceptions being phase denoting atelic perfectives), compare the morphological paradigm in (4a) (pluractional verb signaled with the stem -a-) with (4b) (semelfactive verb with the stem -nou-) where only the former aktionsart can participate in the L-construction (5). And note that this constraint cannot be explained as a result of some telicity prohibition on swarms since semelfactives are atelic.

(4)  a. blýsk-a-t ‘glitter’ pluractional  
     b. blýsk-nou-t ‘glitter once’ semelfactive

(5)  a. Jeskyně se blýsk-a-la diamanty.  
     ‘The cave glittered with diamonds.’
     b. Jeskyně se *blýsk-nu-la diamanty.  
     ‘The cave glittered with diamonds #once.’

The leading idea of Dowty’s approach to swarms is that in the L-construction, the ground subject is described by predicates of small and frequently repeated events. Because there are many events, there are many corresponding sub-regions where each event is located, and an addressee of L-constructions (according to Dowty) has an intuitive feeling of texture perception (thus the name “dynamic texture hypothesis”). Dowty’s theoretical claim then is that there is a transfer of events to locations analogical to aspectual transfers between incremental themes and their predicates. Dowty’s reasoning nicely explains the data contrast in (6) (from Dowty 2000: p. 123): the PP objects in L-construction seem to be only indefinites (mostly bare plurals or mass nouns) and any explicit and precise cardinality information leads to an ungrammaticality.

(6)  a. The room swarmed with mosquitoes.  
     b. The room swarmed with a hundred mosquitoes.  
     c. ??The room swarmed with seventy-three mosquitoes.  
     d. My philodendron is crawling with dozens of snails.  
     e. ??My philodendron is crawling with fifty-seven snails.

Dowty explicitly claims that swarms are argument alternations similar to middle or conative alternations and for him are derived in the lexicon where (via lexical rules) un-appropriate candidates for L-constructions are filtered out. And analogically to other alternatives, he conceives one pattern as basic, semantically default/un-marked and purely compositional. For Dowty, it is the A-construction (this idea is in some form shared by all other linguists working on swarms).

Dowty mentions another important observation concerning an inference distinguishing A- and L-construction, which is the total affectedness inference mentioned in section 1. For Dowty, in accordance with his events to locations mapping, that results in a total impact of the whole location, as demonstrated in (7) from Dowty (2000). Whether total affectedness equals mapping to all sub-regions of the L-subject is a point of controversy, but it seems like a valid observation concerning examples like (7).

(7)  a. Bees are swarming in the garden, but most of the garden has no bees in it.  
     b. #The garden is swarming with bees, but most of the garden has no bees in it.
2.2. Hoeksema’s scalar approach to \textit{swarms}

Hoeksema’s analysis differs in many important aspects from Dowty’s dynamic texture hypothesis. Hoeksema first correctly points out that not all subjects of \textit{swarms} are strictly speaking locative. But they always express a high degree of affectedness. See (8) and (9) from Hoeksema (2009), where neither John nor walls are plausible locations of the \textit{swarming} events.

(8)   a. Q: Was John angry?
     b. A: He was foaming with fury.

(9)   a. Q: Was the crowd loud?
     b. A: The walls were vibrating with their cheers.

On the positive side, Hoeksema claims that \textit{swarms} are degree constructions with a causative component, in his words: “the object of \textit{with} causes the subject to exhibit a high degree of some property by completely affecting it” from Hoeksema 2009: p. 20. Let’s notice that: i) this concerns just L-construction so that the syntactic derivation would proceed from the non-causative A-construction to the causative L-construction – in accordance with the un-marked status of A-construction; ii) the causative L-\textit{swarm} differs from the usual causative constructions where the causation source is in the majority of cases encoded in the subject position. Whatever the real syntax-semantic analysis of L-constructions turns out to be,\textsuperscript{2} Hoeksema’s analysis seems to be well supported in its degree approach to \textit{swarms} – a point verified by our experiments too.

Hoeksema supports his claims with the following data: i) L-constructions as in (10) (after Hoeksema 2009: ex. 41) are compatible with high degree modifiers and incompatible with adverbs modifying low degrees (we found this effect in our experiments too); ii) the degree analysis correctly predicts scalarity based inferences concerning affectedness of L-construction subjects, see (11) (after Hoeksema 2009: ex. 40). Let us illustrate the second point intuitively: (11) would be true even in a scenario where e.g., the first half of the book is extremely full of typos, while the second part is totally without them: once some contextually given threshold of high degree is exceeded, the L-construction becomes true. We consider this second observation very compelling, and we are preparing an experiment to test its general validity.

(10)  a. The book is literally littered with typos.
     b. The yard was absolutely lousy with vermin.
     c. ??The book is somewhat littered with typos.
     d. ??The yard was a bit lousy with vermin.

(11) The book is littered with typos.

After establishing the degree nature of L-construction \textit{swarms}, Hoeksema (2009) discusses their polarity properties – some short note concerning \textit{swarms’} polarity can be found in Hoeksema 2018 too. Based basically on two reasons, Hoeksema classifies \textit{swarms} as PPIs. The first reason is theoretical: Hoeksema claims that many high degree predicates (as extreme adjectives, some types of idioms, etc.) are PPIs and offers some preliminary reasoning about that concerning very weak information value of such predicates under negation. The second reason is empirical: based on careful investigations of \textit{swarms} natural occurrences and some cross-

\textsuperscript{2}We believe that proposals of Gehrke and McNally 2014 where it is hinted at incorporation analysis of \textit{swarms} are maybe more promising.
linguistic corpus evidence (English and Dutch mostly), he shows that L-construction *swarms* avoid negation and downward entailing contexts. He uses Fisher’s test to calculate expected frequency (based on non-*swarm* predicates) and compares them with in the corpus observed frequency of positive vs. negated *swarm*-predicates. In the majority of cases, it seems that *swarm*-predicates occur either only in positive sentences or if negated, they appear with statistically significantly smaller frequency than generic types of non-*swarming* predicates. We ran some similar queries in the Czech national corpus (Křen et al. 2015) with similar results.\(^3\)

2.3. Degree constructions and polarity

In recent years linguistic interest in the polarity constraints of degree constructions had arisen. They are studied either from a mostly empirical point of view (Hoeksema, 2018), mostly theoretical perspective (Spector, 2014) or some mixture of both with an experimental approach (Solt, 2018; Solt and Waldon, 2019). The area seems to be less understood than in the case of NPIs as frequently mentioned, so there is nothing like a standard recipe for degree polarity items. But we’ll focus now on Solt (2018) and her treatment of approximators, which seem to empirically resemble the polarity effects revealed by *swarms* as we will argue in the following sections.

First, let us start with the basic data patterns and theoretical tools that Solt (2018) uses to deal with them. The most important polarity contrast concerning approximators is illustrated in (12) (after Solt 2018: ex. 20): approximators like English *about* act as PPIs, not tolerating negation if they modify numerals: (12a) vs. (12b). But if the approximator is embedded in comparative quantifiers, they seem to switch to the exactly opposite side and behave as NPIs: (12c) vs. (12d).

(12)  
\[ \begin{align*}  
\text{a. } & \text{Lisa has about 50 sheep.} \\
\text{b. } & \text{*Lisa doesn’t have about 50 sheep.} \\
\text{c. } & \text{*Lisa has more than about 50 sheep.} \\
\text{d. } & \text{Lisa doesn’t have more than about 50 sheep.} 
\end{align*} \]

The first assumption which Solt makes and which she derives from Katzir (2007) is that the approximator competes with the alternative in which the approximator is deleted. The alternatives for (12a) are then \{*about 50 sheep, 50 sheep*\}. The immediate problem then is that unlike the run of the mill polarity effects with *even* and bare numerals (strong NPIs like *even one book* is standardly assumed to evoke alternatives like \{*1 book, 2 books, 3 books, …*\} – see Crnič 2011; Krifka 1995), the approximators are by definition vague, and in the right context, both bare and approximator-modified numerals are logically equivalent, consequently neither is logically stronger or weaker than the other one.

Solt acknowledges this obstacle and proposes that using approximators is a reasonable conversational turn only in such cases where the speaker signals that imprecision is overtly signaled;

\(^3\)We gathered frequencies of three most common Czech *swarms* in positive and negative sentences and compared them with frequencies of their non-*swarm*-alternating counterparts: *swarms* hemžit se ‘swarm’, bzučet ‘buzz’, třástat se ‘tremble’ and their corresponding verbs pohnout se ‘move’, zpívat ‘sing’ and hýbat se ‘move’. We summarized their 2x2 contingency tables and have found a significant association between polarity and the *swarm*\|non-*swarm* status: \(\chi^2(1) = 56.72, p < 0.001\). The odds of occuring in a negated sentence were 1.9 times higher for non-*swarms* than in the case of *swarms*, \(\phi = 0.045\). As the odds ratio and the Cramér’s \(V\) show, the effect was very weak.
consequently the bare numerals are interpreted exactly (not in the 'at least,' lower bounded way), and approximators denote non-trivial range around the bare numeral denotation.

Simplifying Solt’s formalization then yields (13a) as a (contextual) meaning of (12a) and (13b) as the meaning of bare numeral alternative of (12a): \( k_i \) denotes the non-trivial range dependent on the context \( i \).

(13)  
   a. \( \max \{ n : \text{Lisa has } n \text{ sheep} \} = 50 \)  
   b. \( \max \{ n : \text{Lisa has } n \text{ sheep} \} \in [50 - k_i, 50 + k_i] \)

Notice that (13a) is logically stronger than (13b), so the assertion of the approximator-modified numeral yields an implicature that the speaker was not in a position to assert the bare alternative. But such an implicature is, in this case, innocent and, in fact, compatible with the usage of approximator as a signal of exact uncertainty.

But in the case of negated sentences containing approximator-modified numerals the entailment reverses: the negated modified numeral (\( \neg \max \{ n : \text{Lisa has } n \text{ sheep} \} \in [50 - k_i, 50 + k_i] \)) entails the negated alternative with the bare numeral (\( \neg \max \{ n : \text{Lisa has } n \text{ sheep} \} = 50 \)), and corresponding double-negated implicature (\( \neg \neg \max \{ n : \text{Lisa has } n \text{ sheep} \} = 50 \)) contradicts the original assertion resulting in blocking and PPI behavior of the approximator-modified numerals.

Notice that in the negated case, the bare alternative is not logically stronger but weaker; thus, at least in the standard neo-Gricean approaches to NPIs, it would not be considered as competing with the assertion. Solt is fully aware of this complication and suggests that there are two factors beyond the proposed concurrence: i) simplicity – partially following Katzir (2007) she considers the bare alternative simpler, as it can be derived from the approximator-modified version via deletion; ii) entailment defined as “definitely stronger than” relation which requires to be true across all possible interpretations (in all contexts). Because qua the relation “definitely stronger than” the two alternatives are logically equivalent (even if in some interpretations one is contextually stronger than the other one) and the bare alternative is always simpler, there is concurrence between the two even if they are (across contexts) logically equivalent. In simple words, to formalize the concurrence between the approximator-modified numeral and the bare-numeral, one has to take into account both the logical and structural properties of the alternatives.

The general recipe then is: if the simpler alternative is logically weaker (in some contexts), its non-assertability leads to a contradiction resulting in the blocking of the asserted sentence (containing approximator modified numerals in the case at hand). If the simpler alternative is logically stronger, its non-assertability is innocent. In the case of approximators embedded in comparative quantifiers, the entailment reverses (against the basic pattern discussed in the current section), and the NPI pattern emerges (see Solt 2018 for details).

We will apply this sort of reasoning to the polarity behavior of swarms in section 4 as there are many properties connecting approximators with swarms: both are degree constructions that are context-dependent and exhibit patterns of polarity sensitivity depending on the scale standards. Generally, both constructions differ from the more studied and more understood polarity items, so the usual standard polarity frameworks like Krifka (1995) cannot be straightforwardly applied to them.
The details of our experiment results and the first steps to formalize them will be described below, but let us shortly foreshadow the patterns and our way of dealing with them theoretically. First, the core pattern which emerged from our experiments (all the details are in the section 3) is demonstrated with English examples below: both positive and negative sentences do allow swarm L-construction ((14a) and (14b)). But if the L-construction is modified with completely type of degree booster, the modified L-construction becomes unacceptable if it is negated ((14c) vs. (14d)). Second, we take this resemblance between swarms and about approximators seriously (recall the PPI pattern of approximators in (12)) and in the theoretical part (section 4) apply Solt’s reasoning to swarms: in case of modified L-construction, the negated bare alternative (the alternative without completely modifier) is logically weaker and consequently its non-assertability blocks the realization of the modified L-construction as (14d).

(14) a. Bees are swarming in the garden.
   b. Bees aren’t swarming in the garden.
   c. Bees are completely swarming in the garden.
   d. #Bees aren’t completely swarming in the garden.

3. Experiments

The question that comes to mind is what is the distinction between Czech A-constructions and L-constructions. For this purpose, we run two experiments to test the various properties of these two swarm-constructions. In the first experiment, we asked whether L-construction exhibits high degree properties and whether it behaves as PPIs (Hoeksema, 2018). Based on the results from the first experiment showing that unmodified swarms do not behave as PPIs, we conducted the second experiment focusing on L-constructions modified with modifiers of maximality. In this section, we present both experiments, their results, and the consequences. The experiments basically show that modified L-constructions are PPIs, unlike unmodified L-constructions, but they seem to be a different type of PPIs.

3.1. Experiment 1

The first experiment aims to confirm Hoeksema’s intuition that L-constructions exhibit a high degree of a predicate’s property. We tested both A-constructions and L-construction to show the differences between them. Since L-constructions are supposed to be high degree constructions, A-constructions are considered to have default/semantically un-marked status by both main approaches presented above.

3.1.1. Procedure & Participants

The experiment was run on the IBEX farm, and the participants filled the experiment online. The experiment began with the instructions following with the practice part where it was illustrated in three practice examples of what the participant’s task is. Then, participants filled the test part itself. There were two types of sentences in the experiment: (i) tested sentences, so-called items, and (ii) sentences that were supposed to distract and, at the same time, verify that the participants pay attention, so-called fillers. Items alternated with fillers. We used the Latin square design; the experiment was presented in such a way that each item appeared only once in the whole experiment for each subject, whereas individual conditions cycled with the subjects. The order of items and fillers was presented to each participant randomly. 50 Czech
native speakers participated in the first experiment.

3.1.2. Design & Material

The experiment consisted of the acceptability judgment task: we used the 5-point Likert scale from 1 (absolutně nepřijatelná věta “completely unacceptable sentence”) to 5 (věta je naprosto v pořádku “completely acceptable sentence”). We tested whether the sentences are acceptable for Czech native speakers or not. There were 32 items and 32 fillers in total in the experiment. We used four conditions, and each condition was varied for L-construction and A-construction; the design of the experiment then was 4x2, eight conditions in total. The sample item for L-construction is in (15). We present here L-construction since this construction is crucial for our following analysis, and it was expected to observe a desirable effect in it. The four conditions were as follows: 1) REF in (15a) – The baseline condition was the reference level; there were bare swarm constructions. 2) DEG in (15b) – Swarm constructions were modified with a low degree modifier trochu ‘slightly’. Assuming that L-constructions exhibit high degree properties and behave as PPIs, this condition should be unacceptable for participants, since the low degree modifier is inconsistent with the high degree properties of predicates. 3) NEG in (15c) – Swarm constructions were negated to detect avoidance of PPI contexts. Swarm constructions were expected to be unacceptable for participants provided swarms behave as PPIs, as suggested by Hoeksema (2009). 4) RESC in (15d) – this condition tested the rescuing of swarms in iterated DE contexts. Taking into account that swarms were suggested to have PPI’s properties, this condition should be more acceptable than the condition NEG since swarm predicates should be rescued.

(15)  a. Ta louka bzučela včelami.
     the meadow.SBJ buzz.3SG.PST bee.PL.INS
    ‘The meadow buzzed with bees.’       REF
  b. Ta louka trochu bzučela včelami.
     the meadow.SBJ slightly buzz.3SG.PST bee.PL.INS
    ‘The meadow slightly buzzed with bees.’  DEG
  c. Ta louka nebzučela včelami.
     the meadow.SBJ NEG.buzz.3SG.PST bee.PL.INS
    ‘The meadow didn’t buzz with bees.’      NEG
  d. Jestli dnes louka nebzučí včelami, tak zítra
     if today meadow.SBJ NEG.buzz.3SG.PRS bee.PL.INS then tomorrow
     bude.
     be.3SG.FUT
     ‘If the meadow doesn’t buzz with bees today, it will buzz tomorrow.’   RESC

3.1.3. Results & Discussion

We analyzed the data statistically. First, we evaluated fillers; they were uncontroversially acceptable or unacceptable Czech sentences, and we checked whether the average of each participant’s responses to unacceptable fillers was lower than the average of their responses to acceptable fillers. All the participants successfully passed the fillers; therefore, we kept all of them in the subsequent analysis. Responses in the experiment were modeled by a mixed-effects linear model with subject and item random effects (in R package ordinal). Both random-effects
were treated as random intercepts and random slopes. The independent variables were: Conditions (DEG, NEG, RESC, and the reference level REF), and Construction: (A-construction – ACON, L-construction – LCON) and their interaction. The dependent variable was the subject’s responses. The Error bars graph nicely summarizes the acceptability of each condition in Figure 1.

![Error bars graph](image)

**Figure 1.** Error bars of responses (means and standard errors).

It is evident from the mere sight of the error bars graph that A-construction was always better in each condition. Moreover, something seems to be happening with the condition DEG. We observe that the condition DEG is less acceptable than all other conditions.

The linear regression model was constructed as follows: i) the response variable was the subjects’ answers, the explanatory variable was the condition with four levels (DEG, NEG, RESC, REF); ii) the reference level condition was REF level. The explanatory categorical variable was treated in the R defaults way (treatment contrasts). The 4x2 design was fitted by way of interaction, the subjects’ responses were modeled as an interaction between the CONDITION (4 categorical levels) and the construction (2 categorical levels: ACON, LCON). The estimated coefficients in Table 1 show how much the three levels of the variable CONDITION differ on average from the reference condition. As is clear from the z-values and p-values, only the level DEG is significantly different from the reference level.4

The model further reported significant effect of CONSTRUCTION and three significant negative interactions: CONSTRUCTION with DEG, CONSTRUCTION with NEG and CONSTRUCTION with

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4To check the reliability of the interaction model, we fitted the data with another model without interactions and with main effects only. The ANOVA comparison of the two models confirmed that the interaction model was significantly better ($p < 0.001$).
Table 1. The statistical output.

|     | Estimate | Std. Error | z value  | Pr(>|z|)   |
|-----|----------|------------|----------|------------|
| DEG | -0.724307 | 0.114374   | -6.333   | 2.41e-10 *** |
| NEG | 0.007611  | 0.116197   | 0.066    | 0.947776   |
| RESC| -0.119997 | 0.114384   | -1.049   | 0.294145   |

The z-values clearly show that CONSTRUCTION effect was much stronger than the interactions.

Table 2. The statistical output: the interaction effects.

|     | Estimate | Std. Error | z value  | Pr(>|z|)   |
|-----|----------|------------|----------|------------|
| ACON| 1.102949 | 0.131216   | 8.406    | < 2e-16 *** |
| DEG:CON | -0.578378 | 0.171478 | -3.373   | 0.000744 *** |
| NEG:CON | -0.589774 | 0.177291 | -3.327   | 0.000879 *** |
| RESC:CON | -0.622380 | 0.174732 | -3.562   | 0.000368 *** |

Since the Construction effect was much stronger than the interactions, ACON was always better than LCON. The statistical results and descriptive statistics clearly show the overall worse acceptability of LCON, which probably derives from the relative morpho-syntactic markedness of (Czech) L-constructions against ACON. The main negative effect of DEG proves the degree sensitivity of swarms. Technically the interaction of CON with DEG states that L-construction accepts degree modifiers more than A-construction: we would expect bigger decrease of acceptability in the condition DEG (parallel to the condition REF), but both the Figure 1 and the interaction effect in Table 2 show the significant interaction effect.

The results taken together strongly support the degree analysis of swarms and falsify their PPI status. These findings are more consistent with Hoeksema’s degree analysis. Nevertheless, swarms do not show real PPI behavior, which goes against the polarity analysis of them in Hoeksema (2009) (and partially similar notes concerning extreme adjectives in Morzycki 2012).

### 3.2. Experiment 2

Following the results obtained from the first experiment, we raised the following question: whether a modification of L-constructions with negation may lead to unacceptability. Our research goal was to bring new reliable data about polarity effects of high degree vague predicates as their profile is very different from the more studied and understood the existential type of PPIs (Spector 2014, among others).

#### 3.2.1. Procedure & Participants

The procedure of the second experiment was identical to the first experiment: the experiment was run on IBEX farm again; there were the introduction, the practice part, and the test part. Participants had to judge items and fillers, and the way of the presentation remained similar as in the first experiment, i.e., we used the Latin square design again, but we added context against
which the subjects rated both grammaticality and appropriateness. 38 Czech native speakers participated in the second experiment.

3.2.2. Design & Material

The experiment consisted of a truth-value judgment task: the subjects had to judge both the grammaticality and contextual appropriateness of one of the conditions (for each item) in the context. We used the 5-point Likert scale from 1 (věta je naprosto nегramatická a neodpovídá kontextu “the sentence is completely ungrammatical, and it is not appropriate in the context”) to 5 (věta je naprosto gramatická a odpovídá kontextu “the sentence is completely grammatical, and it is appropriate in the context”). There were 16 items and 16 fillers in total in the experiment.

We tested various types of L-constructions with modifiers of maximality úplně ‘completely’. The sample item is in (16). Due to the lack of space, we present a context only for the first condition since contexts for the other three conditions were slightly modified, e.g., to ensure that úplně ‘completely’ is interpreted as scoping over negation. The four conditions were as follows: 1) REF in (16a) – The baseline condition was the reference level; there was a positive verb. 2) DE in (16b) – The tested sentences contain the downward entailing expression málokdy ‘rarely’. 3) NEG in (16c) – Swarm constructions were negated. 4) RESC in (16d) – We used negated questions for testing of eventual rescuing.

(16) The context: A human rights march is held regularly every month in the town. On average, about 180 human rights activists participate in the march. Today, exactly 180 participants met on the square. Policeman Ales calls his superior and says the following sentences:

a. Dnes se náměstí úplně rojí bojovníky za lidská práva.
   ‘Today, the square is completely swarming with human rights activists.’

b. Minulý rok se náměstí málokdy úplně rojilo bojovníky za lidská práva.
   ‘Last year, the square was rarely completely swarming with human rights activists.’

c. Dnes se náměstí úplně nerojí bojovníky za lidská práva.
   ‘Today, the square is not completely swarming with human rights activists.’

d. Nerojí se dnes náměstí úplně bojovníky za lidská práva?
   ‘Isn’t the square today completely swarming with human rights activists?’
Based on our intuition, we expected that only both negation and modification by maximality modifier \textit{úplně} ‘completely’ lead to unacceptability. The non-technical explanation is such that the use of maximality modifiers (or eventually intensifiers), e.g., \textit{úplně} ‘completely,’ fix the high degree of swarm constructions. Still, the negation causes that the high degree is not valid anymore, which goes against the expected high degree properties of swarms. The condition NEG was supposed to be unacceptable since the negation is rarely compatible with intensifiers (Castroviejo and Gehrke, 2019).

3.2.3. Results & Discussion

The procedure of analyzing data was identical to the analysis of the first experiment. First, we evaluated fillers, and since all the participants successfully passed the fillers, we kept all of them in the subsequent analysis. The responses were modeled by a mixed-effects linear model (in R package \textit{nlme}). The random effects were subjects and items, and the fixed effects were four conditions REF, DE, NEG, RESC. Participants’ answers were modeled as functions of the fixed effect. The descriptive statistics show the statistically significant effects and their \textit{t} ratios: the pairwise differences using Tukey’s honestly significant adjustment is in Table 3.

<table>
<thead>
<tr>
<th>contrast</th>
<th>estimate</th>
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<th>df</th>
<th>\textit{t} ratio</th>
<th>\textit{p} value</th>
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</thead>
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<td>NEG – DE</td>
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<td>643</td>
<td>-3.069</td>
<td>0.0120</td>
</tr>
<tr>
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<tr>
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<td>0.127</td>
<td>643</td>
<td>9.626</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

\textbf{Table 3.} The pairwise differences of Conditions.

The statistically significant effect was between almost all pairs of conditions listed in Table 3. The only statistically non-significant effect was between NEG and RESC. The error bar graph representing the means and standard errors is in Figure 2.

The statistical results and descriptive statistics (visualized in Figure 2) show that L-constructions of swarms, when modified by \textit{completely}-type of a modifier, are degraded in downward monotonic and antimorphic environments. In this respect, the experiment confirms Hoeksema’s claims (2009; 2018) about the polarity sensitivity of swarms. But contrary to standard types of PPIs, \textit{completely}-modified swarms seem not to be rescuable. To our ears, the polarity question was the best possible rescuing candidate from PPI rescuing environments. However, even here, the modified swarms were not acceptable.

On the other hand, there is a difference between swarm constructions and previously studied degree predicates modified with intensifiers (see Castroviejo and Gehrke 2019), which allow being embedded in downward entailing environments which is not true for the \textit{completely}-modified swarms as the statistically significant difference between REF and DE shows. To account for the data, we propose a partially semantic and pragmatic theory of swarm’s polarity behavior discussed in the following section.
Figure 2. Error bars of responses (means and standard errors).

4. Analysis

Based on the results from the experiments and observations from the *swarm* literature, we suggest that L-construction lexicalizes a degree argument, unlike A-construction. And since both current formal theories of *swarms* (Hoeksema 2009, 2018; Dowty 2000) of *swarm* constructions lack real formalization, we propose the following event formalization (in the style of Champollion 2015) extended with a degree semantics for L-constructions. In formalizing this idea, we follow Umbach’s (2011) and Sæbø (2010) in using split positive formative to encode the high degree inferences, the inferences of L-constructions in our case. The proposed syntactic tree with semantics for L-construction is as follows: the pluractional meaning of L-construction is a set of events at type \( \langle v \rangle \), it is converted via pos\(_0\) into a function from events to degrees, namely such events exceeding in the appropriate scale (cardinality of events in prototypical *swarms* but also intensity) a contextual standard \( S \). The contextual standard is, in fact, maximum standard, as is clear from the baseline REF acceptability (experiment 2) and independently verified by two experiments on Slovak *swarms* in Vlášková (2020), we will elaborate on this point a bit further. But what is important type-wise is that L-construction is in this phase of semantic composition open for degree modifiers (of the right type). After adding the degree modifier, the second part of split positive formative (pos\(_1\)) is added, and the verbal projection is interpreted as a set of events.
Via this formalization, we argue that L-construction lexicalizes a degree argument, and therefore, it is accessible for degree modification. We will illustrate our reasoning on the formalization of a schematic L-construction sentence *The hillside swarmed with skiers*. The formalization steps are the following: the inner box in (18) denotes a measure function (pos₀); at this point, the degree modifier can be added. The second part of positive formative (pos₁), i.e., the outer box in (18), shifts the measure function into a predicate of events. The semantics is motivated by the fact that L-constructions are compatible with degree modifiers, unlike A-constructions that do not lexicalize a degree argument and cannot be modified with them, see (19) as a formalization of A-construction version of the discussed sentence (empirical support comes from the interaction effects in the experiment 1 which pointed out better acceptability of degree modification with L-constructions).

(18)  \[ \exists X \subseteq \text{skiers} \land \exists e[\swarm(e) \land \{\mu_{\text{card}}(e) - S(\mu_{\text{card}})\} > 0 \land \loc(e) = t(\text{hillside}) \land \ag(e) = X] \]

(19)  \[ \exists X \subseteq \text{skiers} \land \exists e[\ag(e) = X \land \swarm(e) \land \loc(e) = t(\text{hillside})] \]

The next step is to try to formalize the results from the second experiment, where degree semantics and polarity interact. We describe each condition step by step. We basically claim that the modified version of swarms with completely-type modifiers is blocked by a non-assertability of its unmodified version in downward entailing environments. In other words, the unmodified version is, at least in some contexts, logically stronger than the modified version. Still, a speaker is not in a position to assert it in downward entailing environments, which results in the blocking of the modified version too. In this way, we follow Krifka’s (1995) neo-Gricean approach to PPIs and, more particularly, Solt’s (2018) application of Katzir’s (2007) theory of structurally derived alternatives to PPIs introduced in section 2.3. In case of the swarms and their polarity sensitivity, we believe that both bare swarms (BS) and completely-modified swarm (CMS) are vague, as the maximum standard is computed from the mapping between the location denoting subject (Dowty, 2000) and the set of events denoted by the verb. Nevertheless, the point of adding a ‘completely’ modifier is to fix the contexts (C) to those where CMS expresses the degree of swarms exceeding or being equal to the maximum standard. Let’s apply the reasoning to the results from the second experiment.

In the condition REF (sentences like *Today, the square is completely swarming with human rights activists*), we claim that the CMS competes with a structurally more simple BS. Follow-
ing the previous discussion, we formalize the degree inferences of the bare swarm construction via a split positive formative introduced above in (18) as follows:

\[(20) \quad \lambda e.[\ast \text{swarm}(e) \land (\#e - \max(S_\#)(C)) = 0]\]

Such a set of swarming events where the degree of the relevant scale, e.g., cardinality, intensity, measuring the events is equal to the maximum-standard in the context C (remember, swarms behave as maximum standard degree constructions). On the other hand, CMS enforces the degree to lie in the interval starting at the maximum-standard in the particular context C and to exceed it by contextually given variable \(k(C)\). The formalization of CMS is the following, boosting, in fact, the maximum standard:

\[(21) \quad \lambda e.[\ast \text{swarm}(e) \land (\#e - \max(S_\#)(C)) \in [0, k(C)])]\]

Recall that unlike the modified L-construction, its negated version was unacceptable. The contrast was introduced intuitively in (14) and then confirmed experimentally with the significant difference between the referential and \textsc{neg} conditions of experiment 2. Now we will discuss the technical explanation of the contrast. The competition between BS and CMS leads to an epistemic inference concerning the non-assertability of BS, see (22), which is compatible with the meaning of CMS, where the degree exceeds the maximum-standard. In prose: speaker uttering CMS signals that the degree of swarming exceeded the maximum standard, and it’s not true that he believes that it is equal to the maximum standard, plausible interpretation for CMS.

\[(22) \quad \neg Bel_s(\lambda e.[\ast \text{swarm}(e) \land (\#e - \max(S_\#)(C)) = 0])]\]

In the condition \textsc{neg}, we assume that the negation scopes over the split positive. The negated BS and CMS meanings are in (23a) and (23b), respectively.

\[(23) \quad \begin{align*}
  \text{a.} \quad & \lambda e.[\ast \text{swarm}(e) \land \neg(\#e - \max(S_\#)(C)) = 0]) \\
  \text{b.} \quad & \lambda e.[\ast \text{swarm}(e) \land \neg(\#e - \max(S_\#)(C)) \in [0, k(C)])]
\end{align*}\]

The negated CMS characterizes the degree of swarms to lie under the maximum-standard, but the negation of BS, especially if strengthened, clashes with the negated meaning of BS. The formalization of the negation of BS is in (24). The assertion of CMS claims the degree of swarming to be under the maximum standard. Still, the double negated BS alternative in (24) contradicts the assertion as it equals the degree of swarming with the maximum standard. Consequently, the CMS is blocked by the structurally defined alternative. Notice, that BS is logically weaker than CMS in negated sentences, so we have to work with simplicity as a tool for deriving alternatives as Solt (2018).

\[(24) \quad \neg Bel_s(\lambda e.[\ast \text{swarm}(e) \land \neg(\#e - \max(S_\#)(C)) = 0])])\]

In prose: CMS is logically weaker than its bare alternative, consequently the epistemic implicature of the bare L-construction falsity is still compatible with the assertion of CMS (similarly to a simple propositional logic analogy: \(p \lor q\) is logically weaker than \(p\) and eventual falsity of \(p\) is compatible with the assertion of \(p \lor q\). But if the modified L-construction is negated, CMS becomes logically stronger than its bare alternative and the epistemic implicature of BS falsity is devastating as claiming both (stronger) \(p \land q\) and negating (weaker), \(p\) would lead to a contradiction (\(\bot\) : \((p \land q) \land \neg p\)). Next, we introduce the technical explanation of other experimental results, but all of them are built upon the same core reasoning discussed in the
In the condition $\text{DE}$, we assume the competition between BS and CMS again. The downward entailing frequency adverb under negated believe operator of BS alternative can be strengthened, as is schematically formalized in (25): the improbability comes from the diverging claims of the assertion (the maximum standard was rarely reached), and the negated alternative (which claims that rarely the maximum standard wasn’t achieved). Even if BS is still compatible with CMS, it is very improbable to get both assertion and its implicature true. As such, it can explain why, in the experiment, the condition $\text{DE}$ is more acceptable than the condition $\text{NEG}$.

(25) \[ \text{Bel}_S(\text{rarely} > \neg > \text{swarm}_{\text{max}}) \]

In the last condition $\text{RESC}$, we explain the polarity question’s inability to rescue CMS as a remaining clash between the non-assertability of BS, which results in blocking of CMS. The same recipe we described for $\text{NEG}$: questioning the polarity of $\text{REF}$ still requires the computation of its sentence-radical meaning first.

In this section, we made the first step in formalizing swarm constructions. We propose the formalization of basic types of swarm constructions. Moreover, we extended the formalization for more complex swarm constructions, i.e., for the swarms with completely-type of modifiers. Our formalization is based on the results from two experiments in Czech. We are aware that our proposed semantics is work in progress and definitely not a final description of swarm constructions. Still, we are the first one to come up with a real formalization explaining both the scalar behavior of L-construction swarms and their polarity constraints.

5. Conclusions

In this paper, we report the results of two experiments on Czech swarms. Empirically their results are the following: i) L-construction shows clear signs of scalarity like the acceptability of degree modification by expressions targeting the maximum standard of scales; ii) there is a complex pattern of L-construction polarity behavior; namely, it resembles other degree polarity sensitive constructions as approximators. Theoretically, both experiments support the degree approaches to swarms (like Hoeksema 2009) and the degree-polarity interaction work like Solt (2018). As for the novel insights, we bring new independent empirical evidence for the PPI behavior of degree constructions.

References


The temporal perspective of epistemics in Dutch

Annemarie VAN DOOREN — University of Maryland, College Park

Abstract. A series of experiments is conducted on naïve native speakers of Dutch and English to study the scope relation between tense and epistemic modality. The results are consistent with the claim that epistemics scope over tense (Stowell 2004, Hacquard 2006, a.o.), and challenge recent research that states that epistemics can, or must, scope under tense (von Fintel and Gillies 2007, Rullmann & Matthewson 2018): Dutch and English participants in a Truth Value Judgment Task judge sentences to be false when the past tense forms of the modals have to and moeten 'have to' are used to make an epistemic claim that held at a time before speech time, and true when they are used to make an epistemic claim that holds at speech time. Moreover, English participants in an Acceptability Judgment Task judge sentences to be infelicitous when the same past tense form of have to is used to make an epistemic claim that held at a time before speech time. Besides these general patterns, the results show variation within and across the two languages, which leads to interesting new questions about the interaction between tense and (epistemic) modality.

Keywords: modality, epistemics, tense.

1. Introduction

This paper is concerned with the interaction between tense and epistemic modals in Dutch and English. Epistemic modals such as must and moeten 'must' in (1) are used to express the notion of a likelihood. A series of experiments is conducted, the results of which are consistent with the relatively old claim that epistemic modals scope over tense (Groenendijk & Stokhof 1975, Iatridou 1990, Stowell 2004, Condoravdi 2002, Hacquard 2006, 2010, a.o.), and challenge more recent papers which argue that English and Dutch modals can or must scope under tense (von Fintel & Gillies 2007, Rullmann & Matthewson 2018).

(1) a. John must be home, since his car isn't in the parking lot.
   b. Marie moet wel op vakantie zijn, want ze neemt haar telefoon niet op.
   'Mary must be on a trip, as she's not picking up her phone.'

The debate revolves around the question where epistemic modals are interpreted relative to tense within their own clause. On the surface, modals seem to appear below tense, since they bear tense morphology. And indeed, non-epistemic modals, such as the deontics in (2) are interpreted in the scope of tense: The interpretations of the past tense modals in (2) are of obligations that held at some point in the past. Note that the semi-modal had to is used to demonstrate the interaction in English, as English modal auxiliaries such as must do not carry tense morphology; all Dutch modals however carry tense morphology.

1 I would like to thank Valentine Hacquard, Anouk Dieuleveut, Ailís Cournane, Nick Huang, Dan Goodhue, Alexander Williams, and the reviewers and the audience at Sinn und Bedeutung 24. Many thanks also go to the ModSquad @ UMD/NYU, as well as the volunteers who participated in the Dutch experiment. This project is supported in part by NSF grant #BCS-1551628.

(2) a. John had to be home by 10, since his parents told him so.  
   b. Marie moest om 10 uur thuis zijn van haar ouders  
     'Mary's parents obliged her to be home by 10.'

Some researchers have argued that epistemic modals in contrast outscope tense (Groenendijk & Stokhof 1975:68-69, Iatridou 1990, Stowell 2004, Hacquard 2006, 2010, 2011 and Hacquard & Cournane 2016, a.o.). The crucial datapoints involve again the interpretation of past tense epistemics, since two possible orderings of the scope-bearing elements are in principle available: The epistemic modal could scope under tense, giving a sentence like (3) the interpretation of a past likelihood (3i) (a past temporal perspective, Condoravdi 2002), or the epistemic modal could scope over tense, locating the evaluation time of the modal at the local time of evaluation, which in matrix sentences is speech time. The sentence is thus interpreted as a current likelihood (3ii) (a present temporal perspective).

(3) John had to be home, since his car wasn't in the parking lot.
   Option i. 'Given what I knew then, it was necessary that John was home.'
   Option ii. 'Given what I know now, it is necessary that John was home.'

Note that this second interpretation, which is the one argued for in this paper, is unexpected: While the past tense marker is on the modal, it does not backshift the evaluation time of the modal. The epistemic modal is evaluated at speech time. The tense marker is instead interpreted under the modal, shifting the event under the modal to the past.

What is at stake? The claim that epistemics scope over tense has been used to show that epistemic modals are structurally high in the clause: they take a large sized complement, including a TP (4) (Cinque 1999, Hacquard 2006, 2010), while root modals scope under tense and are thus structurally low. So, the interaction between tense and modality is used to argue that modals that can be used to express both a likelihood (an epistemic) and an obligation (a deontic), are in different structural positions depending on its use.

(4) ModEpistemic > Tense > ModRoot > Verb         (Cinque 1999, Hacquard 2006, a.o.)

In contrast, Rullmann & Matthewson (2018), who argue that past tense epistemics scope under tense, propose that modals are uniformly in a structurally low position (5).

(5) Tense > ModP > Verb                     (Rullmann & Matthewson 2012, 2018)

In the next section the crucial datapoints are discussed that researchers have brought forward for the interpretation of past tense epistemics in (3). This discussion results in an empirical impasse: English datapoints that according to Hacquard (2006, 2010, 2016) support the view that epistemics scope over tense are argued to be 'marginal at best' by Rullmann & Matthewson (2018). Datapoints that according to Rullmann & Matthewson (2018) support the view that epistemics scope under tense are claimed to be special by Hacquard (2006, 2010, 2016) in that they involve context shift: under special circumstances, a past temporal operator in a higher clause can make it appear like the epistemic is evaluated in the past, but
in fact, the epistemic is still evaluated at the now shifted local time of evaluation. The impasse warrants a quantitative study using naïve speakers of English, and adding Dutch, in which the crucial datapoints can be tested. Two initial studies are described in section 3. The conclusion follows in section 4.

2. The debate

The two claims about the structural height of epistemic modals make different predictions: If epistemics are structurally below the tense marker in their clause, the evaluation time is the time expressed by tense. For past tense epistemics, this means that they are evaluated at a time before speech time (a past evaluation time, Table 1). If epistemics are structurally above tense, the evaluation time is the local time of evaluation. For past tense epistemics in matrix contexts, this means that they are evaluated at speech time (a present evaluation time); in embedded contexts, the local time of evaluation may be in the past. Arguments in favor of each claim are discussed below.

<table>
<thead>
<tr>
<th>Tense &gt; Epistemic</th>
<th>Evaluation time of the epistemic</th>
<th>Past epistemic in matrix context</th>
<th>Past evaluation time</th>
<th>Present evaluation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Rullmann &amp; Matthewson 2018)</td>
<td>Time expressed by tense</td>
<td>+</td>
<td>-</td>
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<tr>
<td>Epistemic &gt; Tense (Cinque 1999, Hacquard 2006, a.o.)</td>
<td>Local time</td>
<td>-</td>
<td>+</td>
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2.1. Epistemics scope over tense

The view that epistemic modals scope over tense can be found in Groenendijk & Stokhof (1975:68-69), Iatridou (1990), Stowell (2004), Hacquard (2006, 2010, 2011) and Hacquard & Cournane (2016), a.o. Stowell's example is in (6); a context that helps bring out the intended reading is two speakers discussing how many people were at a party last night. The epistemic modal seems to be evaluated at speech time: Given the evidence available at the time of speech, it is necessary that there were at least a hundred people at that party last night.

(6) There **had to** be at least a hundred people there.

'There must have been at least a hundred people there.' (Stowell 2004:626)

It could be argued, however, that in this particular example, the evaluation time is in the past and continues to hold: At some time in the past, it was necessary given the evidence that was available then that there were at least a hundred people there (Valentine Hacquard, p.c.; for a similar reasoning on different examples, see Rullmann & Matthewson (2018:326)).

In the example in (7) from Hacquard (2010), this analysis is not available, as there is an explicit contrast between a past and a present evaluation time: In the past, Poirot thought that Mary was home at the time of the murder, but more recently, he established that she was home. The question is, can **had to** in this context target the past evaluation time, which would make the sentence true? Hacquard claims the sentence in (7) with the past tense modal is
judged as false, which supports the claim that *had to* cannot be used to make an epistemic claim that held at a past time, i.e., the epistemic modal cannot scope under tense.

(7)  
(Context:) Imagine that the evidence gathered at the beginning of a murder investigation (a week ago) pointed to Mary being home at the time of the murder: both Mary and her roommate testified that they were having lunch together there. Yesterday however, Poirot established that Mary’s roommate had lied, as she was seen by several eyewitnesses elsewhere at that time, debunking Mary’s alibi. Mary *had to* be home (at the time of the crime).

Hacquard & Cournane (2016) furthermore claim that there is a contrast between epistemic *modals*, such as *have to*, and epistemic *verbs*, such as *seem*: Only epistemic *modals* scope over tense. Hacquard & Cournane first set up a context in which there is again both a past and a present evaluation time, as in (8). They then contrast an epistemic modal claim using *seemed* (8a) with *had to* (8b) and state that while (8a) is false in this context, (8b) is true. From this they conclude that *had to* can target a present evaluation time.

(8)  
(Context:) Al has been a prime suspect for a crime that occurred last night in Montreal. Up to now, all of the evidence pointed to him being in Montreal last night. But just now, the detective receives fresh evidence that proves that Al was in fact in DC last night.

  a. It *seemed* that Al was in DC last night/ Al *seemed* to be in DC last night.
  b. Al *had to* be in DC last night.     (Hacquard & Cournane 2016: 4)

Together, the examples in (6)-(8) support the claim that epistemic *modals* can, and in fact *must* scope over tense. What is more, the contrast with *seem* shows that this scope relation is specific to epistemic *modals*, as opposed to epistemic *verbs*: In the exact same set-up, epistemic *modals* target a present evaluation time, while epistemic *verbs* do not.

2.2. Epistemics scope *under* tense

Von Fintel & Gillies (2007) and Rullmann & Matthewson (2012, 2018) argue instead that epistemics *can* (Von Fintel & Gillies 2007), or *must* (Rullmann & Matthewson 2012, 2018) scope under tense. Support is provided by further datapoints, in which epistemic modals appear to have a past evaluation time (section 2.2.1.), and by a re-evaluation of the datapoints brought up in the previous section (section 2.2.2.). The disagreement about which datapoints should be used to show the interaction between epistemic modals and tense, and what the judgment is for these datapoints, demonstrate the need for the experiments in section 3.

2.2.1. Further datapoints

Rullmann & Matthewson (2018) respond to the examples in which a past evaluation time does not seem to be available by stating that while a past evaluation time for past epistemics might be dispreferred, it is available in natural speech and in construed examples (9)-(10). In (9a), for instance, the epistemic claim about there being at least a hundred people seems to
hold before speech time. Rullmann & Matthewson (2018:284) argue that these examples show that in Dutch and in English,² typically tense scopes above the modal.

(9) a. When Susan arrived at Bob's house, she saw that the place was packed. There had to be at least a hundred people there. But she found out later that actually, there were only 60. (Rullmann & Matthewson 2018:298)

b. This morning I opened my phone bill and was shocked when I saw that I owed $10,000. This had to be a mistake! Unfortunately, it turned out to be correct. My husband had used my phone on his latest trip to Papua New Guinea, forgetting about the roaming charges. (Rullmann & Matthewson 2018:297)

(10) (Context:) I was looking for Jan last night. I had searched all his usual haunts except his house and hadn't found him yet.

Jan moest wel thuis zijn.

'John had to be home.' (Rullmann & Matthewson 2018:285)

Boogaart (2002) notes that past epistemics can occur in such contexts but states that the contexts are marked in that they involve free indirect discourse: a discourse in which the perspective is shifted to one of the agents in a story, without it being overtly marked. Hacquard (2006, 2010, 2016) follows Boogaart's proposal and analyzes sentences like (9) on a par with cases of embedded modals (11). She claims that in these cases, epistemics still outscope tense and are as such evaluated at the local time of evaluation (Table 1): The local time of evaluation, however, has been shifted to the past. The epistemic modal is evaluated at the time of the past discourse (9)-(10) or the past tense embedding verb (11).³

(11) Two days ago, Poirot thought that Mary had to be the murderer. (Hacquard 2011: 28)

Evidence for the shifted time in cases of free indirect discourse comes from deictic temporal adverbials like now, which can refer to the narrator's now in sentences like (9b), as in (12), which is past relative to utterance time (Hacquard 2016:57). The same argument can be made for the Dutch example in (10), shown in (13).

(12) (Modification of (9a)): This morning I opened my phone bill and was shocked when I saw that I owed $10,000. Now, this had to be a mistake! […]

(13) (Same context as (10)) Jan moest nu (wel) thuis zijn.

Jan must.PST now (PRT) home be

'Jan had to be home now.'

A second type of examples presented in favor of epistemic modals being able to have a past evaluation time (scoping under tense) is in von Fintel and Gillies (2008). The sentence in

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² Rullmann & Matthewson (2018) also discuss the non-Indo-European languages St'át'imcets and Gitksan, for which they claim that epistemic modals scope under tense as well. These languages will not be discussed here.

³ Note that Rullmann & Matthewson (2018) argue that in embedded contexts, epistemics can be further backshifted. This paper focuses on epistemics in matrix contexts but these cases will be evaluated in the future.
(14) seems to mean that at a certain point before utterance time, Sophie thought it was a possibility that there was ice cream in the freezer.\(^4\)

(14) \((\text{Context:)} \) Sophie is looking for some ice cream and checks the freezer. There is none in there. Asked why she opened the freezer, she replies:
There \textit{might have} been ice cream in the freezer.

Hacquard (2006, 2010) notes that this possibility only arises in \textit{why} questions, and analyzes these cases as instances of a covert embedding attitude (15a) (Hacquard 2006), making it similar to the sentences in (11), or a covert \textit{because} (15b) (Hacquard 2010), which is known to be able to shift perspectives (Stephenson 2008).

(15) a. I thought that there \textit{might have} been ice cream in the freezer.
b. \textit{Because there might have} been ice cream in the freezer.

Rullmann & Matthewson (2018:324) support von Fintel and Gillies' analysis and argue against Hacquard's solutions in (15), as neither type of context leads to a past evaluation time of a modal by itself: They observe that in both contexts, only \textit{might} with an embedded perfect (\textit{might have}), but not \textit{might} alone can give rise to a past evaluation time (16a), (17). Note moreover that this is a possibility with an \textit{overt} embedding (16b). Valentine Hacquard (p.c.) responds that perhaps the past evaluation of \textit{might} in (16a) and (17) is dispreferred because of the competition with \textit{might have}.\(^5\)

(16) a. I thought that there \textit{might be} ice cream in the freezer.
   "At a certain time in the past, \textit{it was} possible that there was ice cream." \textit{past}
b. I thought that there \textit{might be} ice cream in the freezer.
   "At a certain time in the past, \textit{it was} possible that there was ice cream." \textit{past}

(17) I looked in the freezer because the ice cream \textit{might be} in there.
   "I looked in the freezer because at a certain point in the past, \textit{it was} possible that there was ice cream." (Rullmann & Matthewson 2018:324) \textit{past}

So far, the disagreement between researchers who claim epistemics scope \textit{over} or \textit{under} tense has been about past tense epistemics in narrative contexts and in answers to \textit{why} questions. While there is agreement that in these contexts, past tense epistemics can be used to express an epistemic claim that held before speech time, there is disagreement about what this shows: For Rullmann & Matthewson (2018) and von Fintel & Gillies (2008), it shows that past tense can scope over epistemic modals, while for Hacquard (2006, 2016) it shows that in special cases, a higher temporal operator can backshift the local time of evaluation, which is the

\(^4\) The past evaluation time of the epistemic in (14) could either arise from the perfect raising over the modal at LF (see Condoravdi (2002) for this analysis for non-epistemic modals), or it could be lexically encoded in the multi-word item \textit{might have} (Rullmann & Matthewson 2018).

\(^5\) Another possibility is that for the past evaluation time to be available in (14), an \textit{overt} past tense marker is necessary, either in the form of a perfect marker, as for English \textit{might have}, or a past tense. Initial support for this idea is that the Dutch past tense modal \textit{kon} 'can.PST' with (i a) and without an underlying perfect (ib) can have a past evaluation time as a response to a \textit{why} question.

(i) a. Het ijs \textit{kon} daar toch \textit{zijn geweest}. \textit{past}  
   the ice can.PST there PRT be been
   'The ice cream might've been there, right?'  
   b. Het ijs \textit{kon} daar toch \textit{zijn}. \textit{past}  
   the ice can.PST there PRT be
   'The ice cream might've been there, right?'
epistemic modals' time of evaluation. The question that naturally follows is whether outside of these contexts, epistemics scope over or under tense.

2.2.2. Re-evaluation of datapoints

Outside of narrative contexts and why questions, Hacquard (2006, 2010, 2016) and Hacquard & Cournane (2016) discuss sentences in which they claim past tense epistemics are evaluated at speech time (section 2.1.). Rullmann & Matthewson (2018) however claim that sentences like the ones in (18) are judged 'marginal at best', which casts doubt on the claim that epistemics scope over tense.

(18) (Context:) Up until just now, all of the evidence pointed to Mary being home last night. But now, fresh evidence proves that Mary’s home was empty last night. Mary had to be out last night. (Rullmann & Matthewson 2018:326)

Rullmann & Matthewson ran a survey on 8 native speakers of English who judged sentences like (18) on a scale from 1-3. They report that 3/8 judged (18) as 'marginal'. What is more, only 3/8 speakers accept Stowell's original sentence from (6) in context (There had to be at least a hundred people there). They furthermore constructed their own example (19), which is judged as infelicitous or marginal by 6/7 speakers they consulted.6

(19) (Context:) A mother is wondering what her son got up to at a party last night. He emerges from his room holding his head and looking green. She says: You had to be drunk. (Rullmann & Matthewson 2018:300)

The contradicting claims about the datapoints are intriguing, and call for further investigation. The experiments described in section 3 complement Rullmann & Matthewson's quantitative results in three ways. First, does the low acceptability for (18) reflect an unavailability of past epistemics to be evaluated at speech time, or a mere dispreference? What could influence the judgment of (18) is a preference for sentences like Mary must have been out/Mary has to have been out (or even Mary was probably out) in these contexts. Here a Truth Value Judgment Task is conducted, which tests whether sentences like (18), while perhaps dispreferred, have an interpretation available in which the epistemic modal is evaluated at speech time. Secondly, while Rullmann & Matthewson (2018:297-298) ran a second survey showing that past tense epistemics are accepted when they make an epistemic claim that held before speech time in narrative contexts, it has not been shown that the same holds in matrix contexts. This condition is tested here. Finally, while the quantitative results reported so far all involve English, the claim that epistemic modals scope under tense has also been made for Dutch. This language is tested in exactly the same conditions as English.

6 See Goodhue, Hacquard & Williams (in progress) for an analysis that the use of have to (vs. must) requires special contexts, which might be responsible for the infelicity in (19).
2.3. Summary of the debate: An empirical impasse

This summary of the debate on the interaction between epistemic modals and tense justifies conducting a quantified experiment on past tense epistemics: In contexts in which there arguably are no additional context shifters, there is disagreement about the judgments themselves. The experiments described in the next section test whether both Dutch and English epistemic modals can or must scope over or under tense.

3. Experiments on past tense epistemics

Two experiments were run online on native naïve speakers of English and Dutch. Participants were recruited using Amazon Mechanical Turk (https://www.mturk.com) for English and Facebook groups (www.facebook.com) for Dutch. The first experiment was a Truth Value Judgment Task, in which participants were asked whether a sentence was considered true or false given a preceding context. The second was an Acceptability Judgment Task, in which participants were asked whether a sentence sounded fine or not within the given context.

3.1. Truth-Value Judgment Task – Design and methods

For the Truth-Value Judgment Task (TVJT), each trial consisted of a context and a test sentence, as illustrated in (20). Participants were asked whether the sentence in bold was true or false given the context. Each context presented evidence at two different points in time, past and present, and was followed by one of four types of test sentences, as shown in (21). Judgments on the critical test sentences (21a, 21c), determine whether the epistemic modal scopes over or under past tense: If the epistemic modal scopes over tense, sentences containing had to should be judged true when they target a present evaluation time (21a), and false when they target a past evaluation time (21c). If the epistemic modal scopes under tense, the judgments for (21a) and (21c) should be reversed: sentences with the modal should be judged false when they target a present evaluation time (21a), and true when they target a past evaluation time (21c). The predictions following from the two claims are in (21) in grey.

(20)  
_Al has been a prime suspect for a crime that occurred last night in Montreal. Up to now, all of the evidence pointed to him being in Montreal last night. But just now, the detective receives fresh evidence that proves that Al was in fact in DC last night._

The detective says: **Al had to be in DC last night.**

(21)  
a. The detective says: **Al had to be in DC last night.** (epi>T: true, T>epi: false)  
b. The detective says: **Al seemed to be in DC last night.** (false)  
c. The detective says: **Al had to be in Montreal last night.** (epi>T: false, T>epi: true)  
d. The detective says: **Al seemed to be in Montreal last night.** (true)

The controls are the same sentences with seemed (21b, 21d). Since seem uncontroversially scopes under tense (8), sentences with seemed are expected to be judged true when they target a past evaluation time (21d), and false when they target a present evaluation time (21b). The two factors tested in the TVJT are summarized below.
Following Hacquard & Cournane (2016), this set-up arguably does not contain context shifters (section 2) and as such, there should be agreement about what the results would show. The contexts used for the Dutch version of the experiment were the same; the epistemic modal in the test sentence is *moest* 'had to', and the epistemic verb is *leek* 'seemed'.

**Materials** Eight contexts similar to (20) were created. For each context, there were four possible test sentences, depending on (1) the lemma tested (*seem*/*leek* vs. *have*/*moeten*) and (2) whether the sentence targeted a past or present epistemic evaluation time. Note that the particle *wel* 'yet' was present in the Dutch *moest* 'had to' sentences but not in the *leek* 'seemed' sentences. It is possible to get an epistemic interpretation for *moest* without *wel*, but it was added to make sure the participants understood the modal epistemically (and not deontically).

In order to avoid a narrative context (see section 2), direct discourse was used in the test sentences, and present tense was used in the context and the question asked. The question asked after each test sentence was 'Is the sentence in bold true or false?' Two further comprehension questions were asked about the contrasting claims in the context after each test question, which measured the attentiveness of the participants. The questions following (20) were ‘Where did the detective originally think Al was?’ and ‘With the new evidence, where does the detective now think Al was?’. The experiment contained all eight contexts, with each of the four conditions in (21) tested twice. The factors *lemma* and *target evaluation time* were counterbalanced across participants.

The experiment additionally contained one training item and eight fillers, which consisted of similar contexts with a past and present evaluation time, and used epistemic adjectives and adverbs to keep participants focused on epistemic claims, in the present or future tense. An example is in (23); all test items and fillers can be found at http://www.annemarievandooren.com/papers-2/.

(23)  *Two friends are betting on which sports team is going to win. Fred thinks the red team is going to win, as they have the better defense. But Paul informs him that the red’s team best defender is out with an injury and the rest of the team can't win without him.*

Fred says: The red team is probably not going to win.

Filler question: 'Is the sentence in bold true or false?'

Comprehension question 1: 'Did Fred originally think the red team was going to win?'

Comprehension question 2: 'With the new evidence, does Fred now think the red team is going to win?'

Participants 40 native speakers of Dutch and 40 native speakers of English based in the United States participated in this study. English participants were recruited through Amazon
Mechanical Turk and paid for their participation. Dutch participants were recruited through e-mail and Facebook Groups targeting Dutch teachers and university students and volunteered.\footnote{The Dutch experiment was originally launched on Amazon Mechanical Turk, but there were no responses.}

Procedure Before starting the experiment, there was one training item with feedback. Participants then judged 16 items in total, eight test items plus eight fillers. Since the 40 participants in both the Dutch and the English experiment were given eight test questions, each of the four conditions was judged 80 times.

Data analysis The responses of the participants were analyzed using a two-tailed binomial test (R Studio Core Team, 2008) to investigate whether the proportions of answers with 'true' are higher or lower than expected by chance.

3.2. Truth-Value Judgment Task – Results

In the English experiment, accuracy on comprehension questions for both trials and fillers is high (mean on all contexts: 86.2% correct, with no differences between the 16 contexts). One participant who performed under 75% on the comprehension questions was excluded. Accuracy on fillers is also very high (mean on all fillers: 94.7% correct).

In the Dutch experiment, accuracy on comprehension questions for both trials and fillers is very high (mean on all contexts: 93.8% correct, again with no differences between the 16 contexts). One participant who performed under 75% on the comprehension questions was excluded. Accuracy on fillers is lower than in English (mean on all fillers: 69.7\%\footnote{There was also a high amount of variation: While 13/40 participants had a perfect score on the eight fillers, 17/40 performed under 75%. I leave it for further investigation to examine more closely potential differences between the Dutch and English fillers, which lead to the lowered performance of some of the Dutch participants.}).

The main results for English are shown in Figure 1. English sentences with had to are judged true 89.7\% of the time, when the target is a present evaluation time, and 6.4\%, when the target is a past evaluation time. Sentences with seemed are judged true with a present target 84.6\% of the time, and 47.4\% of the time with a past target. A binomial test (two-sided) indicates that the proportions of the responses in the present/had to and present/seemed condition are higher than expected by chance, and in the past/had to condition lower than expected by chance (0.5) (Table 2).

The main results for Dutch are shown in Figure 2. Sentences with moest 'had to' are judged true 64.1\% of the time when the target is a present evaluation time, and 23.1\% of the time when the target is a past evaluation time. Sentences with leek 'seemed' are judged true 46.2\% of the time with a present target and 74.4\% with a past target. A binomial test (two-sided) indicates that the proportions of these responses in the present/moest and past/leek condition are higher than expected by chance, and in the past/moest condition lower than expected by chance (0.5) (Table 2).
The temporal perspective of epistemics in Dutch

3.3. Truth-Value Judgment Task – Discussion

**Dutch results** The results are consistent with the hypothesis that epistemic *moeten* 'must' scopes *over* tense in Dutch non-narrative contexts: In contexts with a past and present evaluation time, a sentence with *moest* is judged false when it targets a past evaluation time, while the same sentence with *leek* 'seemed' is judged true. *Moest* moreover tends to be judged as true when it targets a present evaluation time. These results on *moest* are unexpected if the Dutch modal scopes *under* tense.

If Dutch epistemic modals scope *over* tense, why are there still 'true' responses for epistemic *moest* when it targets a past evaluation time, and 'false' responses when it targets a present evaluation time? There are two things to note here. First, there was variation both between and within participants, which I will probe further in future work. Second, some contexts may not have been completely clear about what the evidence showed at the two different time points. One context in particular led to both the highest percentage of 'true' responses with *moest* targeting a past evaluation time (55.6%; average per context 25%), and the highest percentage of 'false' responses targeting a present evaluation time (77.8%; average per context 30.6%). The Dutch version of this context lacked an indicator marking the

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9 One participant consistently gave judgments in line with the interpretation of *moest* as scoping under tense.
incompatibility between the past and the current belief that was present in the English version, which may have lead to the different outcome.10 An unexpected result concerning the control *leek* 'seemed' is that participants are at chance with a present target. Why are sentences like (24) not always judged as false?

(24) *Ad was tot op dit moment de hoofdverdachte voor een misdrijf dat gisteravond plaatsvond in Utrecht. Tot nu toe wees al het bewijs erop dat hij gisteravond in Utrecht was. Maar nu ontvangt de detective een nieuw bewijsstuk dat bewijst dat Ad eigenlijk in Breda was gisteravond. De detective zegt: Ad leek in Breda te zijn.*

Ad has been a prime suspect for a crime that occurred last night in Utrecht. Up to now, all of the evidence pointed to him being in Utrecht last night. But just now, the detective receives fresh evidence that proves that Ad was in fact in Breda last night. **The detective says:** *Ad seemed to be in Breda.*

Note that this result does not change the results for *moest*, as there is still a contrast between *leek* and *moest* in both conditions. What could be the case in (24) is that some participants were focusing on where Ad actually was last night, and since the information provided by the embedded clause answers this question, they may have ignored the past tense morphology on *leek* 'seemed'. In the condition with *leek* and a past target (*Ad seemed to be in Utrecht*), the information provided by the embedded clause does not tell us where Ad was last night, which might have resulted in a more careful parse.

**English results** *Had to* behaves as expected under the hypothesis that epistemic modals scope over tense: It is judged 'true' with a present target and 'false' with a past target. What the experiment fails to show, however, is an informative contrast with the control, *seemed*: With a present target, participants judge sentences with *seemed* as true too, most likely for the same reason as Dutch participants. With a past target, as in (25), English participants are at chance.

(25) *(English version of (24), using Montreal as a past target and DC as a present target): The detective says: Al seemed to be in Montreal.*

Note first that this result does not falsify the hypothesis that *had to* scopes over tense; the results on *had to* are consistent with the claim that *had to* scopes over tense, and inconsistent with the claim that *had to* scopes under tense. What the result fails to show is that in identical contexts, *had to* cannot target a past evaluation time while *seemed* can. There might therefore be a problem with the experiment itself.

What is more, the English results contrast with the Dutch results, as Dutch participants judge sentences with *leek* 'seemed' targeting a past evaluation time as true. The issue thus seems to concern English *seemed* specifically. One possibility is that the sentences with *seemed* do not

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10 Another potential explanation could be that the modal tested in this context does not have an epistemic interpretation for some of the participants (cf. the variation in judgments mentioned in section 2; Boogaart (2002) & Rullmann & Matthewson (2018:326) claim that past tense Dutch epistemic modals cannot be used to express an epistemic claim with a present evaluation time, while Barbiers (1995:202) claims they can). A follow-up study will therefore be an acceptability judgment study to see whether there is variation between datapoints and where this variation comes from.
focus on the epistemic claim as much as *leek*; participants might therefore respond purely to the information provided by the embedded clause and ignore *seemed*. In a follow-up experiment described in section 3.4., the focus was shifted to the epistemic claim by setting up a direct contrast between a past and a present epistemic claim in the test sentence, similar to (26). The prediction is that in this set-up, when *had to* is used to express a past epistemic claim, it is judged as infelicitous while the same sentence with *seemed* are not.\footnote{Another possible follow-up experiment would be to choose an epistemic verb that inherently focuses more on the epistemic claim, i.e. *appear*.}

(26) John \{**seemed, had to**\} to be home, but now I’m not so sure anymore.

3.4. Acceptability Judgment Task – Design and methods

The goal of the follow-up study is to find out whether part of the results from the TVJT were due to a problem with the experimental set-up. Participants did not judge that the English control item *seemed* could be used to target a past evaluation time, in contrast to previous claims (8). The explanation investigated by means of the Acceptability Judgment Task is whether the context did not highlight the past target enough. In a context in which the focus is on the past target, is it possible for *seemed* to target a past tense evaluation? If so, we can compare the results with *had to* to find out whether in the same set-up this epistemic modal can scope under tense. This follow-up was only conducted in English since the TVJT already showed that in the same set-up, Dutch *moest 'had to' cannot target a past evaluation time while *leek 'seemed' can.*

For the Acceptability Judgment Task (AJT), each trial consisted of a context and a test sentence, as illustrated in (27). Participants were asked for their judgment on the sentence in italics, for which they were given a binary choice: Does the sentence sound *fine* or *(a little) strange* within the given context? Each context was followed by one of the two types of sentences in (28), and the judgment of the test sentence in (28a) determines whether English *had to* can scope under tense. Since the sentence contains an explicit contrast between two epistemic statements (*the earth is/isn't stationary*), the epistemic statement expressed by the modal in the first part of the sentence is forced to be evaluated at a time before speech time. If *had to* can scope under tense, sentences containing *had to* should therefore be judged as *fine*. If *had to* cannot scope under tense, sentences containing *had to* should be judged as *(a little) strange*. The predictions following from the two claims are in (28) in grey.

(27) A professor of ancient Greek culture discusses the ideas of some early philosophers. He says: The ancient Greeks worried much about astronomy, but they had some beliefs that have since been shown to be false. For instance, *While the earth *had to* be stationary, it actually isn't.*

(28) a. *While the earth *had to* be stationary, it actually isn't.* (epi>T: not fine, T>epi: fine)
   b. *While the earth *seemed* to be stationary, it actually isn't.* (fine)

The comparison is with the same sentences with *seemed* (28b), which are expected to be judged as *fine*. The factor tested is summarized below.

(29) Lemma: *had to* vs. *seemed*
What the TVJT and the acceptability task have in common is that they do not have a context in the past tense (section 2). In contrast to the TVJT, however, the test sentences in the acceptability task contain an explicit contrast between a past and a present epistemic claim, which should help the participants focus on the available interpretations for seemed.

Materials Six contexts similar to (27) were created. For each context, there were two possible test sentences, depending on the lemma tested (had to vs. seemed). The epistemic claim expressed in the first part of the sentence was always negated in the second part of the same sentence (it actually isn’t).

Each test sentence was followed by the question "Does the sentence in italics sound fine to you within the given context?", which could be answered by making a binary choice: "Yes, this sentence sounds fine", which is interpreted as being felicitous, or "No, this sentence sounds (a little) strange", which is interpreted as being infelicitous.

The experiment contained either two seemed trials or two had to trials. The two conditions were tested between participants in order to prevent participants directly contrasting had to and seemed themselves: While it could be that there is a dispreference for epistemic uses of had to, this experiment is conducted to find out whether the interpretation under discussion is available. There were six versions of the experiment, each containing two out of six contexts. The contexts were in a fixed order within each version of the experiment.

Two training items and four fillers were created in which outdated and updated beliefs were contrasted by means of epistemic attitude verbs, adverbs and adjectives. All test items, training items and fillers can be found at http://www.annemarievandooren.com/papers-2/.

Participants 34 native naïve speakers of English, currently based in the United States, participated in this study. While this number of participants is small, it makes it possible for every unique sentence to be seen by at least five individuals. This makes it comparable to Mahowald et al's (2016) proposal for small-scale acceptability studies. Given that there were six unique sentences for each of the two conditions, and every participant saw two test sentences, at least 30 participants are necessary. Participants were recruited through Amazon Mechanical Turk and paid for their participation.

Procedure Before starting the experiment, there were two training items with feedback. Participants then judged six items in total, two test items plus four fillers. Since all participants were given two test sentences, the 34 participants gave 68 judgments in total.

Data analysis The responses of the participants were analyzed using a two-tailed binomial test (R Studio Core Team, 2008) to investigate whether the proportions of answers with 'sounding fine' or 'sounding (a little strange)' were higher or lower than expected by chance.

3.5. Acceptability Judgment Task – Results
The average accuracy on fillers was high (mean accuracy: 90.4%). Six participants performed under 75% on fillers and were excluded.

28 participants are included in the results: 13 participants in the had to condition, and 15 participants in the seemed condition. The sentences in the had to condition are judged as 'sounding fine' 38.5% of the time, while sentences in the seemed condition in the same set-up are judged as 'sounding fine' 96.7% of the time (Figure 3). A binomial test (two-sided) indicates that the proportion of 'sounding fine' responses for the seemed condition is higher than expected by chance ($p<0.0001$***)

![Figure 3: Proportion of 'fine' answers with a past target for had to (n=26) and seemed (n=30)](image)

3.6. Acceptability Judgment Task – Discussion

Seemed can be used to express a past epistemic claim: In a set-up in which a past epistemic claim is contrasted with a present epistemic claim, native naive speakers of English judge sentences in which seemed is used to express the past epistemic claim as 'sounding fine'. The contrasting results for seemed in the Acceptability Judgment Task as compared to the TVJT support the explanation suggested at the end of section 3.3: The set-up of the TVJT in combination with this particular epistemic verb might not have made the participants focus on the past epistemic claim, which led to a rejection of sentences with seemed targeting a past evaluation time. In the current set-up, the contrast is explicit in the test sentence, which likely led to the different outcome.

The results support the claim that the epistemic modal have to cannot scope under the tense marker in its own clause. While sentences in which seemed is used to express a past epistemic claim are judged as 'sounding fine', identical sentences with had to are not. This result on had to is unexpected if the English modal scopes under tense.

Why did some participants judge the trials with had to as fine? I.e., why is the acceptability for had to with a past evaluation time more than 38%, while it is much lower in the TVJT? This question will be left for future research but one interesting thing to note is that participants were quite consistent in their judgments: Each participant was given two trials of the same condition, and 8/10 'fine' judgments for had to trials were given by the same
participants. That means that out of the 13 participants in the *had to* condition, four participants judged both sentences as 'sounding fine', seven participants judged both sentences as 'sounding (a little) strange', and only two participants had mixed judgments.

3.7. General discussion

The two experiments together provide support for the claim that the Dutch epistemic modal *moeten* 'have to' and the English modal *have to* do not scope under tense in non-narrative contexts. While in identical set-ups, the past tense form of the epistemic verbs *lijken* 'seem' and *seem* can be used to make a past epistemic claim in matrix contexts, the same is not true for the two epistemic modals. This result is unexpected if the modals scope under tense. The results from experiment 1 furthermore provide support for *moeten* and *have to* being able to scope over tense: in matrix contexts, past tense *moest* and *had to* can be used to express a present epistemic claim about a past event.

Besides these general tendencies, there is variation within and between speakers of the same language, and across the two languages, which will need to be explored further. For instance, is there systematic variation between datapoints, and if so, where does it come from (fn. 10)? Finally, the results raise a question concerning the results reported in Rullmann & Matthewson (2018): Are the results they report indeed caused by a dispreference for this use of *had to*, as compared to *must have been* or *has to have been*? Why would there be such a dispreference?

4. Conclusion

Can epistemic modals in Dutch and English be interpreted within the scope of the tense in their own clause? The results of two online experiments support the claim that for Dutch *moeten* and English *have to*, the answer is 'no'. In the contexts tested in the two experiments, sentences with the past tense form of the Dutch epistemic verb *lijken* 'seem' are judged true (TVJT) and with the past tense form of English *seem* as felicitous (Acceptability Task) when they are used to express a past epistemic claim. In contrast, sentences with the Dutch past tense epistemic *moest* and the English past tense epistemic *had to* in exactly the same set-up are not. These results are inconsistent with the claim that *moeten* and *have to* scope under tense.

The results instead support the claim that *moeten* and *have to* are able to scope over tense (34), as they can be interpreted at the local time of evaluation, which in the matrix contexts tested here is speech time. Indeed, sentences with past tense *moest* and *had to* are judged as true by native speakers when they are used to express a present epistemic claim about a past event (TVJT). The tense on the modal is in these sentences interpreted under the modal, shifting the event under the modal to the past.

(34)  ModEpistemic > Tense > ModRoot > Verb
In sum, the results seem to support the claim that epistemic modals scope over tense (Groenendijk & Stokhof 1975, Iatridou 1990, Stowell 2004, Condoravdi 2002, Hacquard 2006, 2010, a.o.), and challenge the claim that English and Dutch modals can or must scope under tense (von Fintel & Gillies 2007, Rullmann & Matthewson 2018).

What makes epistemic modals so special? After all, both epistemic verbs (seem/lijken) and root modals (deontics) scope under tense: it is the combination of being a modal and being used to express epistemic modality that results in the opposite scope relation. Cinque (1999) proposes that there is a universal hierarchy of functional projections in which epistemics scope over tense. Therefore, functional items used to express epistemic modality are in a structural position above tense. Hacquard (2006, 2010) claims that it follows from the specific syntax and semantics of modals: Modals that are located above tense get an epistemic interpretation because they are interpreted relative to a high speech event, while modals that are located below tense are not interpreted relative to the speech event and instead can only get a non-epistemic, root interpretation.

A final empirical contribution of this paper is the development of a new experimental design that can be used to test whether epistemics scope over or under tense in a language. The Acceptability Judgment Task described in section 3.4. directs participants' focus on the epistemic claims themselves, as there is a direct contrast between a past and a present epistemic claim in the same sentence, which seems to help in getting the intended interpretation.

References


Demonstratives as dimension shifters

Christian EBERT — cabuu GmbH, Wernau
Cornelia EBERT — Goethe-Universität Frankfurt
Robin HÖRNING — Universität Tübingen

Abstract. Drawing on earlier work by Ebert and Ebert (2014), we argue that co-speech gestures contribute non-at-issue information by default (cf. Schlenker, 2018), flesh out their proposal that gestural content can be shifted via demonstratives (i.e. demonstratives function as dimension shifters from the non-at-issue to the at-issue dimension), and present experimental validation for this claim.

Keywords: gesture, demonstratives, German so, at-issueness.

1. Gestures

Pioneering work from Kendon (1980) and McNeill (1992) has shown that gesture information can contribute additional semantic content to an utterance that is not already present in the speech signal. In line with these authors we understand gestures as communicative movements of hands and arms transporting emotions, intentions, and thoughts as in the following example.

(1) Die Skulptur, die hat ['n Betonsockel].
    ROUND
    ‘The sculpture has a base made of concrete.’

The utterance in (1) as a whole conveys that the sculpture has a round base made of concrete. The information that the base is round does not stem from the speech signal, however, but from the speech-accompanying gesture. In more traditional gesture research, it is well-known that gestures can add information to an utterance. Kendon (1980) and McNeill (1992) point out that gesture and speech work together to convey one thought. This holds for different types of gestures alike.

While there are many different types of gestures (McNeill, 1992), we will be concerned only with iconic and pointing gestures in this paper. Iconic gestures, as in (1), represent a property of an object or an event and show some direct similarity to what they depict. They are not conventionalized: a round object can be represented gesturally in many different ways (via

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2 The example is from the ‘Speech and Gesture Alignment’ (SaGA) corpus (Lücking et al., 2013) Square brackets around a verbal expression indicate that there is an accompanying gesture that is performed co-verbally. The gesture will be given below the verbal expression. ‘ROUND’ stands for an iconic gesture that depicts roundness. In the corpus example, it was a dynamic gesture performed with both hands in the central gesture space in front of the speaker’s torso.

forming a round shape with the hands, making a circular movement with one hand or with two, etc.) and yet the gesture always means more or less the same, namely ‘round (object)’. Pointing gestures, usually performed with the stretched index finger in our cultural community, identify an object by directing the attention to the object itself. They serve to point to concrete or abstract objects and they can also locate such objects in the gesture space for further reference to them (see Kendon, 2004). Note that pointing gestures can also be used co-speech and then function very much like iconic gestures.

(2) Die Skulptur, die hat [‘n Betonsockel].

POINTING
‘The sculpture has a base made of concrete.’

If the speaker points to a picture of a round base, the recipient will also conclude that the base mentioned in the verbal utterance is or looks similar to the depicted base, i.e. that it is round.

2. The (non-)at-issue status of co-speech gestures

In this section, we will pursue the question how co-speech gesture meaning interacts with the verbal meaning. The main claim is that run-of-the-mill co-speech gestures contribute meaning that is not at issue in the sense of Potts (2005).

As we know, words, phrases, and entire sentences can contribute meanings in different dimensions. This idea, which goes back to Grice (1975) at least, is modeled in different recent frameworks (Potts, 2005; Anderbois et al., 2013; and others). For illustration consider the adjective damn, which has an expressive meaning component indicating that the speaker is emotionally involved and has negative feelings towards the associated concept or object. Nominal appositives as in (3a) and appositive relative clauses as in (3b) are also conceived to contribute non-at-issue material.

(3) a. John, an excellent tennis player, lost five matches in a row.
   b. John, who is an excellent tennis player, lost five matches in a row.

Expressives and appositives are argued to bring in information that is not at issue at the time of utterance, but sneaked in as secondary information. Their contribution is not the main aim of the utterance and not towards what the speaker wants to drive the conversation. Farkas and Bruce (2010) elaborate on the concept of at-issueness vs. non-at-issueness and put forth that at-issue contributions are ‘put on the table’ for discussion, while non-at-issue contributions can enter the common ground without ever being on the table. As such they are silently imposed and enter the common ground without the need for approval by the hearer. For instance, both sentences in (3) communicate 1. that John lost five matches in a row, and 2. that the speaker thinks that John is an excellent tennis player. This second proposition, however, is just sneaked in as secondary information and clearly not what is for disposition.

The following characteristics can be used to test a piece of propositional information for non-at-issueness (Potts, 2005; Potts et al., 2009): 1. it cannot directly be denied in discourse, 2. it cannot be interpreted in the scope of modal operators or negation (i.e. it projects), and 3. it can
be ignored in ellipsis constructions. For instance, if a listener wants to object to the speaker’s assessment of John’s skills as a tennis player, she cannot felicitously do so by a simple denial with ‘No! That’s not true’. Instead, she would have to use some kind of discourse interrupting protest (cf. von Fintel, 2004; Potts, 2015; and Syrett and Koev, 2014, for critical discussion), as in (4).

(4) Hey, wait a minute – actually he is a lousy tennis player.

We argue that co-speech gestures also share these characteristics and thus have to be treated as non-at-issue information. Consider the following utterances (including an iconic co-speech gesture BIG indicating bigness, which we depict here for clarity):

(5) a. I brought [a bottle of water] to the talk.

   BIG

b. I brought a big bottle of water to the talk.

(5a) conveys that the speaker brought a bottle of water to the talk and that the bottle was big, hence roughly the same as (5b). The crucial difference between these utterances lies in the deniability of the size information. While it is perfectly possible to directly deny the bigness of the bottle in (5b) with ‘No! The bottle was small’ one has to use a discourse interrupting protest along the lines of (4) to do so for (5a).

Likewise, if (5a) is modified by a negation (‘I did not bring...’) it cannot be felicitously continued by ‘A small one is enough for me’. Thus, the information conveyed by the gesture cannot be targeted by negation. After all, the negated multi-modal utterance appears infelicitous altogether due to the uninterpretable co-speech gesture. Finally, co-speech gesture content can also be ignored in ellipsis constructions just like other non-at-issue content (see also Potts et al., 2009). (5a) could be felicitously continued by the listener by ‘I also brought one, but actually a small one’ indicating that the gestural bigness information is ignored. Summing up, the co-speech gesture in (5a) contributes information that bears all three characteristics of non-at-issue information discussed above.

3. Demonstratives and their dimension-shifting potential

Although we have seen that co-speech gestures usually contribute non-at-issue meanings there are ways to make gesture contributions at-issue. A case in point is stress, i.e. making a gesture more salient by using more gesture space and possibly adding accompanying facial gestures such as eye-brow raise (see also Esipova, 2018, for discussion of co-speech gestures with contrastive focus). One further important and canonical way to make gesture contributions at-issue content is the use of a demonstrative. For a start, consider the German translation of (5a) in (6) where we added the negative adverbial niemals (engl. never).
(6) Ich bringe niemals [eine Flasche Wasser] mit zu Vorträgen.
I bring never a bottle water with to talks

‘I never bring a bottle of water to talks.’

(6) appears odd due to the uninterpretable accompanying gesture. Like in the case of the negated version of the English original above, the gesture cannot be interpreted as providing a property of the bottle that is explicitly negated by the negative temporal adverb, which is evidenced by the fact that a continuation such as “Eine kleine reicht mir nämlich” (engl. ‘A small one is enough for me’) is clearly infelicitous. Now consider a minimal variant of (6) in (7) that makes use of the German demonstrative SO.

(7) Ich bringe niemals [SO] eine Flasche Wasser mit zu Vorträgen.
I bring never SO a bottle water with to talks

‘I never bring a bottle of water like that to talks.’

Interestingly, here the same elaboration is perfectly felicitous. This shows that the gesture content in (7) now can be targeted by the adverbial. In other words, the size property that the gesture contributes is affected by the semantics of the adverb niemals (engl. never) in the same way as it would be if it was introduced by an adjective (as in “Ich bringe niemals eine große Flasche Wasser mit zu Vorträgen”; engl. ‘I never bring a big bottle of water to talks’). This in turn shows that the gestural meaning component in (7) must have entered the at-issue dimension. We argue that it is the demonstrative SO (engl. so/such/like this) which is responsible for this effect. We analyze SO as a semantically vacuous item whose first and only function it is to shift whatever non-at-issue meaning is expressed by a co-occurring gesture from non-at-issue to at-issue, thus making it available for fully integrated interaction with the semantics of the speech signal.\(^3\)

We claim that demonstratives in general show this domain-shifting behavior. In particular, we suggest that German dies (engl. this) is actually the shifted version of the definite article (cf. Roberts 2002, who also treats demonstratives as definites that presuppose an accompanying demonstration, and Wolter 2006, who treats them as definites which are interpreted relative to other salient situations than non-deictic definites), or in other words: the spell-out of SO der/\(SO\) das. We find support for this construal by looking at diachronic developments in West-and North-Germanic languages (Pfeifer, 1997). Interestingly, after the definite article had developed from the demonstrative, a new strengthened demonstrative evolved that was built from the definite form plus a deictic particle -se, which is the origin for the German demonstrative we use now. At the time, we would find internally inflected forms of this demonstrative such as Germanic den-se (lit. the-ACC.M.SG + deictic particle -se), which overtly illustrate what we propose.

\(^3\)Note that Potts (2005: p. 36) explicitly argues against the existence of this kind of dimension-shifters from non-at-issue to at-issue. We claim that SO and demonstratives in general are precisely this.
4. Semantic Gesture Contributions

To get at a precise formal account we have to ask what the meaning contribution of a gesture is. As a first step towards an answer we take it that an iconic gesture and a pointing gesture make exactly the same kind of meaning contribution. To underpin this idea consider a variant of (5a), where the iconic gesture is replaced by a pointing gesture to a big bottle.

(8) I brought [a bottle of water] to the talk.

POINTING AT A BIG BOTTLE OF WATER

Crucially, both (5a) above and (8) convey the at-issue meaning that the speaker brought a bottle to the talk while silently imposing the non-at-issue meaning that this bottle was big. Pointing to a big bottle while talking about a bottle, we claim, makes the (non-at-issue) contribution that what the speaker talks about should bear some similarity to what the speaker points to. And the same, we conjecture, holds for iconic gestures: what the speaker talks about should bear some relevant similarity to what the gesture depicts.

Given this equal treatment of iconic and pointing gestures we put forth that both make the same basal ‘lexical’ meaning contribution: they both refer to an object/individual. While this idea of referring to a gesture referent (the demonstratum in Kaplan’s terms) is straightforward for a pointing gesture, it requires us to think of an abstract object in case of an iconic gesture that carries at least the features which are crucial for the comparison/similarity that is needed in context. Hence, while the concrete bottle in (8) bears itself the contextually salient size feature, it is an abstract object (filling the space between the palms) that does so in (5a).

What is hence depicted by the iconic gesture in (5a) is not the size property of the bottle, it is the bottle itself (cf. Ehlich, 1986; Umbach and Ebert, 2009) – abstracted over all properties but the contextually relevant one, i.e. size. Just as we do not point to the size property when we point to a big bottle in (8), we do not depict bigness by the iconic gesture in (5a). If pointing just to a property was possible, it should be felicitous to point to an object of about the size of a big bottle (a book, say) in (8). In fact, however, this would lead to infelicity of the utterance. In full analogy to the pointing case, we thus assume that the iconic gesture in (5a) depicts the bottle itself and not just its size property. To sum up: the basal meaning of an iconic and pointing gesture is the establishment of a gesture referent.

However, this meaning component alone cannot account for interactions with the verbal signal in general, and with verbal referents in particular. To this end it is noteworthy that gesture and speech are temporally aligned (McNeill, 1992). This is supposed to mean that the timing of gesture performance w.r.t. the production of the speech signal is decisive for the emergence of gestural meaning contributions. As a particularly simple example consider an utterance of (9) with the iconic BIG gesture co-occurring to the verbal utterance of the noun talk:

4As a disclaimer let us note at this point that deferred reference in the sense of Nunberg (1993) is also possible, i.e. the intended referent is not necessarily the pointing referent, but can be a referent that stands in some obvious relation to it.
I brought a bottle of water to the [talk].

BIG

It is the mere temporal coincidence of the utterance of the noun and the performance of the gesture that lets an interpreter conclude that the abstract gestural referent must be iconically related to the noun meaning (here: talk). As a relation between a talk and an abstract upright object of the size of a big bottle is hard to construe, the gesture seems to be misplaced and the utterance as a whole slightly odd.

To account for this well-established insight from the more traditional gesture literature we propose that a co-speech gesture performance introduces a type of constructional meaning, depending on the type of the temporally aligned verbal item, in addition to its basal meaning. Let us take a closer look at three instances of verbal items, which are of particular interest to us in the context of demonstratives: 1. indefinite and 2. definite determiners and 3. their noun phrase complements.

**Indefinite article.** To illustrate the type of additional constructional meaning that we are after consider utterance (5a) again. As discussed in section 2, the utterance as a whole conveys a non-at-issue statement that the bottle brought by the speaker is big. Given that the iconic gesture refers to an object (as argued in the preceding section), the actually conveyed constructional meaning component is a statement about the similarity of the verbal referent and that gesture object/referent. Here similarity is to be understood as ‘similarity in the relevant dimension in the context’, where we have nothing more to say about the nature and the determination of the relevant dimension at this point. We hence argue that the property information that an iconic gesture often seems to add (such as the size property in example (5a)) comes about by temporal alignment of the gesture with the indefinite, which induces comparison of gesture and speech referent.\(^5\)

**Definite article.** For the definite article matters are slightly different. Consider a context involving two playing cards: an ace of spades to the left and a seven of clubs to the right: \(\spadesuit\ 7\clubsuit\). In this context assume the following utterance:

(10) [The card on the left] is an ace.

POINTING TO THE 7\clubsuit

Intuitively speaking, something feels not quite right. The speaker refers to the card on the left and makes a true statement about it with his verbal utterance. But the pointing seems to be incorrect to the extent that it does not identify that verbal referent, i.e. the card on the left. In other words, we expect the gesture referent to be identical to the verbal referent. We put forth that this identity of referents is the constructional meaning component that arises from the temporally aligned performance of gesture and utterance of a definite article.\(^6\) In a sense we might say that identity is a strengthened version of similarity, i.e. similarity w.r.t. all referents.

\(^5\)Note that Umbach and Gust’s (2014) approach is related to ours in several respects, e.g. w.r.t. the assumption that pointing and iconic gestures refer to individuals, and the involved similarities. However, in their approach similarity is not introduced by gesture-speech alignment, but by demonstrative expressions (cf. section 6).

\(^6\)The same holds for gesture and aligned proper names.
dimensions.

**Noun phrase.** In example (9) we saw already that there seems to be an additional constructional meaning component at play. The BIG-gesture did not seem to fit the kind expressed by the verbal noun phrase *talk*. In other words, we expected the gesture referent to be of the same kind as expressed by the verbal noun phrase. More precisely, the temporal alignment of gesture and noun phrase is responsible for the existence of this *exemplification* (cf. Lascarides and Stone, 2009; Fricke, 2012; Lücking, 2013): the gesture referent must satisfy the property expressed by the verbal noun phrase.\(^7\)

This concludes the informal discussion of the meaning contributions of co-speech gestures. Crucially, as argued for above, all these meaning contributions come in as non-at-issue meanings by default. In the following we will turn to a formalization of these ideas.

5. The Formal Semantics of Co-Speech Gestures

In order to give a formal account we extend the system of Anderbois et al. (2013) (henceforth abbreviated as ABH) slightly. They put forth a dynamic uni-dimensional system for treating appositives in discourse that accounts for the non-at-issue status of the appositives while at the same time allowing for possible anaphoric references across dimensions, i.e. between appositives and the surrounding at-issue material. Since we also need to establish relations between verbal at-issue and gestural non-at-issue discourse referents the ABH system makes a particularly well-suited point of departure. In the following we will discuss the key features of the analysis of co-speech gestures and demonstratives. The interested reader is referred to the appendix of this paper for detailed definitions and to the seminal paper (Anderbois et al., 2013) for further explanation and background.

Like ABH we make use of two distinct propositional variables \(p\) and \(p^*\) to keep track of the meaning contributions of at-issue and non-at-issue material, respectively. While the at-issue proposition designated by \(p\) can be regarded as a *proposal* by the speaker to update the context set, which is open for discussion, the non-at-issue proposition \(p^*\) is silently imposed and not open for discussion (cf. Farkas and Bruce, 2010).

We also adopt ABH’s definition of discourse referents \(x, y, z, \ldots\) as individual concepts of type \(\langle s, e \rangle\). Since we take it that the basal ‘lexical’ meaning contribution of an iconic or pointing gesture is mere reference to an individual \(g\) (as pointed out above), we capture this meaning contribution by establishment of a novel discourse referent for a rigid designator \(I_g\) to the gesture referent \(g\).

\[
(11) \quad [z] \land z = I_g \quad \text{where for all } w \in W : [I_g(w)] = g
\]

At the same time we extend the system of ABH by *relativized identity* \(=_{p}\) that is only evaluated\(^7\)

---

\(^7\)Note that the gesture in (9) is temporally aligned only with the nominal. In fact, there is not even a separate preceding determiner since it occurs only in a contracted form *zum* (= *zu* + *dem*; engl. *to the*) with the preposition. Therefore exemplification really is a distinct meaning component. The same case can be made with co-speech gestures aligned with NPs in quantificational DPs and bare plurals.
w.r.t. the subscripted proposition $p$ as an addition to the standard identity of $ABH = \text{that is evaluated w.r.t. all possible worlds. This notion of relativized identity is crucial for an account of the full range of examples and the differences of definites and demonstratives in particular. The gist of the analysis is the following: while the mere act of pointing is one of rigid designation (i.e., across all possible worlds) this designation enters into propositional meanings on different dimensions via these relativized identities. We refer the reader to the appendix for more formal details and two worked-out examples.

As argued in the preceding section, co-speech gesture performance also introduces a type of 
‘constructional’ meaning, depending on the type of the temporally aligned verbal item, in addition to the basal meaning in (11). Crucially, these meaning contributions are all non-at-issue. The following three cases of co-speech phrases were discussed, where $x$ and $z$ stand for the verbal and gestural discourse referents, respectively.

**Indefinite article.** We put forth that the temporally aligned performance of an indefinite article and a gesture results in an expression of similarity of the gestural referent and the designated indefinite. Formally, we deal with this similarity by a two-place predicate $\text{SIM}$ such that the co-speech performance of an indefinite article (construed as introducing a novel discourse referent $x$) and a gesture (introducing a novel discourse referent $z$ as in (11)) results in a non-at-issue predication $\text{SIM}_p(x, z)$. It is evaluated on the non-at-issue proposition $p^*$ and true if the objects designated by $x$ and $z$ are similar in the relevant dimension in the context.\(^8\)

**Definite article.** In the case of definite articles similarity is strengthened to (relativized) identity $x = p^* z$ (see Roberts 2002 for a related constraint), which comes down to requiring that $x$ and $z$ designate the same object for all worlds of the non-at-issue proposition $p^*$.

**Noun phrase.** For NPs we argued that the relation between verbal and gestural referent is one of exemplification. This simply comes down to requiring that the property expressed by the noun phrase ($N$, say) holds of the gestural referent: $N_{p^*}(z)$.

To illustrate, the utterance of the DP *a bottle* accompanied by a simultaneous pointing gesture to a bottle $b$ in (12a) is analyzed as in (12b).

\begin{itemize}
  \item[(12)] a. \text{[a bottle] POINTING TO b} \\sim \:\text{[x]} \land \text{bottle}_p(x) \land [z] \land z = I_b \land \text{SIM}_p(x, z) \land \text{bottle}_{p^*}(z)
\end{itemize}

This analysis captures the introduction of a novel discourse referent for a bottle, one for the gesture referent (here: the object pointed at), the non-at-issue statement that this bottle and the gesture referent are similar and the non-at-issue statement that the gesture referent is a bottle. To illustrate the impact of the different meaning components it is best to look at cases where mismatches arise and things go wrong. To this end consider an utterance of (13a) where the DP *a bottle* is accompanied by a pointing gesture to a table $t$.

\(^8\)Umbach and Gust (2014) add a third argument to the similarity predicate, which constitutes the set of dimensions with respect to which similarity has to hold.
(13)  
a. Cornelia brought [a bottle].  
POINTING TO t  
b. \[ x \land \text{bottle}_p(x) \land [z] \land z = I_t \land \text{SIM}_p^*(x, z) \land \text{bottle}_p^*(z) \land \text{bring}_p(\text{cornelia}, x) \]

In our approach this assertion with a pointing gesture to table t that accompanies the utterance of the object DP thus comes down to:

at-issue: an at-issue claim that Cornelia brought a bottle, and

non-at-issue: a (false) non-at-issue claim that the table is a bottle and similar to it.

Hence, if Cornelia actually brought a bottle (in the context of utterance), the verbal statement in (13a) is true, but the non-at-issue statement (i.e. the exemplification statement) that the table pointed at is a bottle is false. This accounts for the observed fact that a listener might respond with ‘Yes, but what you are pointing at is not a bottle’ in such a situation. Another such case might involve the similarity statement. Consider an utterance of the slight variation (14a) where the DP a bottle is accompanied by a pointing gesture to a huge 3 litre double magnum bottle B.

(14)  
a. Cornelia brought [a bottle].  
POINTING TO B  
b. \[ x \land \text{bottle}_p(x) \land [z] \land z = I_B \land \text{SIM}_p^*(x, z) \land \text{bottle}_p^*(z) \land \text{bring}_p(\text{cornelia}, x) \]

Again, if Cornelia actually brought a relatively normal-sized bottle, the verbal statement in (14a) is true. In this case also the non-at-issue exemplification claim that the object pointed at is a bottle is true. However, the non-at-issue similarity claim that the bottle Cornelia brought is similar to the huge bottle is false (assuming that size constitutes the relevant dimension for similarity). This accounts for the observed fact that a listener might respond with ‘Yes, but the bottle she brought was not that huge’ in such a situation.

For the case of a definite DP the analysis runs entirely parallel with the difference of similarity being strengthened to identity. To make for a plausible context assume the following sentence to be uttered in a party situation with a lot of different gifts on a table, among them one bottle b, where we wonder who brought what.

(15)  
a. Cornelia brought [the bottle].  
POINTING TO b  
b. \[ x \land \text{bottle}_p(x) \land [z] \land z = I_b \land x =_p z \land \text{bottle}_p^*(z) \land \text{bring}_p(\text{cornelia}, x) \]

At this point, we do not formally spell out the presuppositions of the definite, but we will include it in the list of propositional meaning components that make up the meaning of an assertion of (15a).

presupposition: there is a unique (contextually salient) bottle

at-issue: Cornelia brought that bottle

non-at-issue: the gesture referent is that bottle and is itself a bottle
In a context where Cornelia actually brought that (unique contextually salient) gift bottle on the table, the presupposition is satisfied and both the at-issue proposition and non-at-issue proposition are true. It is instructive again to look at a related mismatch example. Consider the party scenario from above with TWO bottles on the table of gifts, a normal-sized bottle $b$ and a huge 3 litre double magnum bottle $B$. Now let us look at the following example where the verbal utterance mentions the huge bottle, while the pointing is still on the normal-sized one.

(16)  

a. Cornelia brought [the huge bottle].  
POINTING TO $b$

b.  
$[x] \land \text{bottle}_p(x) \land \text{huge}_p(x) \land [z] \land z = I_b \land x = {p^*} z$

$\land \text{bottle}_p^*(z) \land \text{huge}_p^*(z) \land \text{bring}_p(\text{cornelia}, x)$

presupposition: there is a unique (contextually salient) huge bottle  

at-issue: Cornelia brought that huge bottle  

non-at-issue: the gesture referent is that bottle and is itself a huge bottle

In a context where Cornelia actually brought that huge double-magnum bottle $B$ the presupposition is satisfied and the at-issue proposition is true. However, the non-at-issue proposition is false since the gesture referent, the normal-sized bottle $b$, is not identical to that bottle. This explains why a listener might respond with ‘Yes, but the bottle you are pointing at is not that bottle/the bottle she brought’ in such a context.

6. The Formal Semantics of Demonstratives

Starting with the formal semantics of co-speech gestures from the preceding section, it takes only one simple step to describe the semantics of demonstration: it acts as a dimension shifter and makes non-at-issue meaning at-issue. As a particularly clear example that transparently illustrates this effect, consider the before-mentioned German demonstrative $SO$, which we might see as an overt realization of a demonstrative operator $DEM$ that performs the dimension shifting. In our formal setting this simply comes down to a change of the proposition for evaluation from $p^*$ to $p$ and we might specify the effect of this operator as:

(17) \[DEM : \mathcal{P}_p^* \rightarrow \mathcal{P}_p\] for any literal $\mathcal{P}$.

Reminding ourselves that it is the similarity statement $SIM_{p^*}(x, z)$ that comes about by co-speech performance of a gesture with the indefinite article, the effect of $SO$ on the German indefinite article $ein$ will quite simply be a shift of that statement to $SIM_p(x, z)$ (mind the change of the propositional variable). Therefore the demonstrative German version of (12a) will be:

(18)  

a. [SO eine Flasche]  
POINTING TO $b$

b.  
$[x] \land \text{bottle}_p(x) \land [z] \land z = I_b \land \text{SIM}_p(x, z) \land \text{bottle}_p^*(z)$

In order to see the effect of this change, consider the following German demonstrative variant
of the similarity failure example in (14), where a huge bottle $B$ is pointed at.

(19)  

POINTING TO $B$
b. $[x] \land \text{bottle}_p(x) \land [z] \land z = I_B \land \text{SIM}_p(x,z) \land \text{bottle}_p(z) \land \text{bring}_p(\text{cornelia},x)$

Accordingly, the at-issue/non-at-issue contributions differ from those of (14):

at-issue: Cornelia brought a bottle which is similar to the gesture referent  
non-at-issue: the gesture referent is itself a bottle

Now, if Cornelia actually brought a normal-sized bottle, the verbal statement in (19a) is false. Albeit she brought a bottle, the bottle she brought is not similar to the huge gesture referent. This accounts for the observed fact that a listener might now felicitously respond with (the German translation of) “No, the bottle she bought was not that huge” in such a situation, in contrast to what was the case for (14). The seemingly small effect of the demonstrative of shifting the constructional similarity meaning contribution to the at-issue dimension is responsible for a quite severe change in truth-conditions.

Again, the case of the German demonstrative determiner dies (engl. this) runs parallel. As we argued above, it is reasonable to view these demonstrative determiners as being semantically decomposed into SO + definite determiner, such that this receives the meaning of [SO the]. If we adopt this idea, we will see the effect of shifting the non-at-issue constructional meaning of identity $x = p, z$ to the at-issue dimension. The demonstrative variant of (15) thus turns out as:

(20)  

a. Cornelia brought [this bottle].  
POINTING TO $b$
b. $[x] \land \text{bottle}_p(x) \land [z] \land z = I_b \land x = p, z \land \text{bottle}_p(z) \land \text{bring}_p(\text{cornelia},x)$

Before turning to the at-issue/non-at-issue contributions we need to take a closer look at presuppositions first. To this end consider an utterance of (21) in the party scenario from (15) above with TWO bottles on the table of gifts (a normal-sized bottle $b$ and a huge bottle $B$).

(21)  

# Cornelia brought [the bottle].  
POINTING TO $b$

Empirically the utterance of (21) results in a presupposition failure in this scenario, where two salient bottles are present and thus the uniqueness presupposition of the definite fails. In contrast, an utterance of (20a) in the same context does not leave the listener with a squeamish feeling, which calls for an explanation if we assume that the demonstrative this is essentially a shifted version of the definite the. Our explanation resorts to the proposed dimension shifting. As shown formally in (20b) the at-issue content of the demonstrative expression [this bottle] includes the (shifted) identity statement $x = p, z$. Therefore the content decisive for the evaluation of the uniqueness and existence presupposition is not only the property of being a bottle as in

\footnote{Again, we assume that size constitutes the relevant dimension for similarity (cf. Umbach and Gust, 2014).}
the plain definite case, but the property of being a bottle which is identical to the gesture referent (see Wolter, 2006). Overall, the propositional meaning components in the analysis (20b) are as follows.

**presupposition:** there is a unique (contextually salient) bottle which is identical to the gesture referent

**at-issue:** Cornelia brought that bottle

**non-at-issue:** the gesture referent is that bottle (and is itself a bottle)

This is the correct analysis. In the two-bottle scenario, (20a) is true if Cornelia actually brought the normal-sized bottle pointed at. Crucially, it is FALSE if Cornelia brought the huge double-magnum bottle, allowing a listener to respond with “No, in fact she brought the other bottle” in contrast to (16), where ‘false pointing’ does not affect the truth value of the sentence and the utterance comes out as true. The analogous case to (21), which gives rise to a presupposition failure with a demonstrative, would be when a speaker utters (20a) in the two-bottle scenario while pointing to both bottles at the same time.

Kaplan (1989) puts forth that demonstratives (as well as pure indexicals) are directly referential, independent of the circumstances of evaluation. Our proposal can be seen as an implementation of this insight. We take the mere act of pointing to be one of rigid designation. Crucially, this designation may enter into propositional meanings on different dimensions. While gestural meaning components start out as non-at-issue by default, demonstrative expressions are responsible for making these components at-issue, allowing them to enter into the truth-conditions proper. In this sense, our approach should be understood as an elaboration of Kaplan’s approach (see the appendix for details).

7. Experiment 1: At-Issueness

This section aims at experimentally validating our claim that speech-accompanying gestural contributions are of a different nature than corresponding verbal contributions. In particular, we want to corroborate our claim that co-speech gestures are non-at-issue contributions. Furthermore, we give experimental support to the proposal that German SO is a dimension shifter, which can shift gestural material (non-at-issue by default) to the at-issue dimension.

Experiment 1 used a sentence–picture matching task to show that a mismatch induced by at-issue material (a property expressed by an adjective as part of the assertion) impairs matching judgments more strongly than a mismatch induced by non-at-issue material (a property expressed by a speech-accompanying gesture). The two-factorial design crossed the two within-factors **MODE** (Adjective vs. Gesture) and **MATCH** (Match vs. Mismatch). The core hypothesis claims an interaction of the two factors such that the Mismatch effect—the decrease in the perceived conformity between sentence and picture due to the mismatch as indicated by the difference between judgments in the **Match** and the **Mismatch** conditions—is stronger if the mismatch is induced by an adjective compared to a gesture.

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10 See Tieu et al. (2017, 2018) for experimental studies on the nature of the non-at-issueness of co-speech gestures.
Method

Participants. 40 native speakers of German, all of them students of the University of Stuttgart, took part in Experiment 1. They were paid 4 € for the session which took about half an hour.

Materials. 24 experimental items were constructed, each one pairing an utterance with a picture. A male student assistant verbalized all sentence stimuli of Experiment 1 while being videotaped. In the Adjective condition, the speaker verbalized the sentence with an adjective (rund, engl. round) in sample (22), but without accompanying gesture; in the Gesture condition, he verbalized the sentence without an adjective, but with an iconic gesture temporally aligned with the indefinite. As for (22), the speaker traced a circle with his index fingers in front of him while uttering the indefinite einem Fenster (engl. a window).

(22) In diesem Bild ist eine Mauer mit einem {runden} Fenster zu sehen. ‘In this picture you see a wall with a {round} window.’

The videotaped utterance was paired with a matching picture (Match condition) or a mismatching picture (Mismatch condition). As for (22), the matching picture showed a wall with a round window, the mismatching picture showed a wall with a rectangular window. The four variants of the 24 experimental items were assigned to four lists according to a Latin square design. The same 48 filler items were added to all four lists.

Procedure. Participants were tested individually at a PC. The session started with a practice trial followed by the experimental items intermixed with the fillers in a randomized order for each participant. Trials began with the presentation of the picture. With a press of the space bar, the picture disappeared and the video started. After the video had finished, a scale appeared on the screen extending from 1 = ‘no match’ to 5 = ‘perfect match’. Participants had to rate how well they thought that the description given in the video matched the picture they saw. They gave their judgment by means of a mouse click on the number of the scale.

Results and Discussion

The data were aggregated per condition per participant ($F_1$ analysis) or item ($F_2$ analysis) and subjected to a repeated measures ANOVA. The analysis confirmed the predicted interaction of MODE $\times$ MATCH [$F_1(1,39) = 93.7^{***}$; $F_2(1,23) = 68.6^{***}$]. The graph to the right shows that the Mismatch effect is stronger in the Adjective conditions than in the Gesture conditions. In addition, there were significant main effects of both factors [MATCH: $F_1(1,39) = 556.1^{***}$; $F_2(1,23) = 127.9^{***}$; MODE: $F_1(1,39) = 164.0^{***}$; $F_2(1,23) = 102.1^{***}$].

To summarize, Experiment 1 clearly supports the stronger Mis-
match effect induced by adjectives compared to gestures and thus corroborates the assumption that the noun modification is at-issue if conveyed by adjectives, but remains non-at-issue if conveyed by speech-accompanying gestures.

8. Experiment 2: At-Issueness Shift

Experiment 2 extended the design of Experiment 1 by adding a third level to the factor MODE: a gesture accompanied by the German demonstrative SO (Dem+Gest conditions). The hypothesis claims that the demonstrative shifts the gesture meaning from non-at-issue to at-issue. The demonstrative is hence expected to boost the Mismatch effect of the gesture to the strength of adjectives and thus to a higher strength than for gestures without a demonstrative. It is predicted that MATCH interacts with MODE if Dem+Gest is compared to Gesture but not if it is compared to Adjective.

Method

Participants. 32 native speakers of German were acquired as participants of Experiment 2 via ZAS Berlin. They were paid 5 € for the session, which took about half an hour.

Materials. For Experiment 2, the 24 experimental items from Experiment 1 were supplied with a third video taped description for the new condition Dem+Gest. The sentence was the same as the one in condition Gesture except that simultaneously with the performance of the gesture the speaker uttered the demonstrative SO, illustrated in (23). It was taken care that the speaker pronounced the demonstrative with a strong accent. All sentence stimuli were verbalized by a female student assistant while being video-taped. The six variants of the 24 experimental items were assigned to six lists according to a Latin square design, with all lists also equipped with the 48 fillers.

(23) In diesem Bild ist eine Mauer mit SO einem Fenster zu sehen.
    ‘In this picture you see a wall with a window like this.’

Procedure. The procedure was the same as in Experiment 1 except that participants judged the sentence–picture pairs on a scale from 10 = ‘no match’ to 1 = ‘perfect match’.

Results and Discussion

The data were analyzed as in Experiment 1. Repeated contrasts were applied to the three-level factor MODE in a way that the Dem+Gest condition was compared to both the Adjective and the Gesture condition. The results are shown in the graph to the right (for the sake of comparability, the values at the y-axis are plotted oppositely to those of Experiment 1).

The analysis confirmed an overall interaction of MODE × MATCH
Experiment 2 confirms the predicted stronger Mismatch effect of mismatching gestures with the demonstrative SO than without a demonstrative. This finding agrees with the hypothesis that the demonstrative shifts the gesture meaning from non-at-issue to at-issue. However, the Mismatch effect in the Dem+Gest conditions turns out to be still less strong than in the Adjective conditions.

9. General Discussion

We presented an analysis of the semantic contribution of co-speech gestures to the meaning of verbal utterances. The analysis resulted in two main claims. 1. the semantic contribution of a co-speech gesture, by default, has the status of non-at-issue information, and 2. an accompanying demonstrative like German SO shifts this non-at-issue meaning to the at-issue dimension. Experiment 1 addressed the first claim by hypothesizing that the perceived mismatch between a picture and a description of it is impaired less if the mismatch is due to non-at-issue gestural information compared to a mismatch induced by at-issue verbal information. Experiment 1 confirmed a less strong Mismatch effect for co-speech gestures than for adjectives and thus provides strong evidence in favor of the assumed difference in status with respect to at-issueness. Experiment 2 replicated the result of Experiment 1 by demonstrating again a less strong Mismatch effect for co-speech gestures without accompanying demonstrative in comparison to adjectives. In addition, Experiment 2 partly supported our second claim that demonstratives like German SO are dimension shifters. The experiment showed that the Mismatch effect induced by a co-speech gesture is significantly stronger if accompanied by the demonstrative SO. Our hypothesis, however, was not completely affirmed, as this Mismatch effect was still weaker than the one induced by an adjective. Thus, we must assume some kind of gradedness in the categorical distinction between at-issue and non-at-issue.

References


Appendix

The formal system listed here is a modified version of the formal apparatus of Anderbois et al. (2013). The most important change is the introduction of a relativized identity \( \equiv_p \) that is only evaluated w.r.t. the subscripted proposition \( p \) in addition to the standard identity of ABH \( \equiv \) that is evaluated w.r.t. all possible worlds. As in the main text, presuppositions are not spelled out formally. This and further elaboration of the system are future work.

**Interpretation of symbols and variables.**

for every predicate symbol \( P \):
\[
\lbrack P \rbrack^{w,h} = \mathcal{I}(P)(w)
\]

for every constant symbol \( c \):
\[
\lbrack c \rbrack^{w,g} = \mathcal{I}(c)(w)
\]

for every variable \( x_{(i,e)} \):
\[
\lbrack x \rbrack^{w,e} = g(x)(w)
\]

**Interpretation of literals.**

a. \[
\lbrack P(t_1,\ldots,t_n) \rbrack = \{ \langle g,h \rangle \mid g = h \text{ and for all worlds } w \in h(p) : \langle \lbrack t_1 \rbrack^{w,h},\ldots,\lbrack t_n \rbrack^{w,h} \rangle \in \lbrack P \rbrack^{w,h} \}
\]

b. \[
\lbrack t_1 =_p t_2 \rbrack = \{ \langle g,h \rangle \mid g = h \text{ and for all worlds } w \in h(p) : \lbrack t_1 \rbrack^{w,h} = \lbrack t_2 \rbrack^{w,h} \}
\]

\[
\lbrack t_1 \neq_p t_2 \rbrack = \{ \langle g,h \rangle \mid g = h \text{ and for all worlds } w \in h(p) : \lbrack t_1 \rbrack^{w,h} \neq \lbrack t_2 \rbrack^{w,h} \}
\]

\[
\lbrack t_1 \equiv_p t_2 \rbrack = \{ \langle g,h \rangle \mid g = h \text{ and for all worlds } w \in h(p) : \lbrack t_1 \rbrack^{w,h} = \lbrack t_2 \rbrack^{w,h} \}
\]

c. \[
\lbrack [v] \rbrack = \{ \langle g,h \rangle \mid g [v] h \}
\]

d. \[
\lbrack \phi \land \psi \rbrack = \{ \langle g,h \rangle \mid \text{there is a } k \text{ such that } \langle g,k \rangle \in \lbrack \phi \rbrack \text{ and } \langle k,h \rangle \in \lbrack \psi \rbrack \}
\]

e. \[
\lbrack \text{max}^p(\phi) \rbrack = \{ \langle g,h \rangle \mid \langle g,h \rangle \in \lbrack [p] \land \phi \rbrack \text{ and there is no } h' \text{ s.t. } \langle g,h' \rangle \in \lbrack [p] \land \phi \rbrack \text{ and } h(p) \subset h'(p) \}
\]

f. \[
\lbrack \text{MIGHT}^p(\phi) \rbrack = \{ \langle g,h \rangle \mid \langle g,h \rangle \in \text{max}^p(\phi) \text{ and for all worlds } w \in h(p) : \text{MB}(w) \cap h(p') \neq \emptyset \}\]

(g. \[
\lbrack \text{NOT}^p(\phi) \rbrack = \{ \langle g,h \rangle \mid \langle g,h \rangle \in \text{max}^p(\phi) \text{ and } h(p) \cap h(p') = \emptyset \}
\]

The meaning of a pointing gesture to an object \( g \) is captured by a rigid designator \( I_g \), i.e. an individual concept for which we require
\[
\text{for all } w \in W : \mathcal{I}(I_g)(w) = g.
\]

In the following we give two worked out examples of a possibility modal statement which differ minimally in the choice of a definite vs. a demonstrative expression. The context of utterance is supposed to be one involving two playing cards: an ace of spades to the left and a seven of clubs to the right:

\[
\spadesuit \hspace{1cm} 7\clubsuit
\]

**Example 1: Definite Description and Pointing in Modal Context.**

a. It is possible that [the card on the left] is not the ace of spades.

POINTING TO A\spadesuit
b.  \[
\text{MIGHT}^\text{prop}_{p'} \left( [z \land z \models \text{left}_{\text{card}_{p'}}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \right)
\]

\[
\text{MIGHT}^\text{prop}_{p'} \left( [z \land z \models \text{left}_{\text{card}_{p'}}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \right)
\]

\[
= \{ (g, h) \mid (g, h) \in \max^{\text{prop}} [z \land z \models \text{left}_{\text{card}_{p'}}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \}
\]

= \{ (g, h) \mid (g, h) \in [[p']] \land [z \land z \models \text{left}_{\text{card}_{p'}}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \}

\text{and for all worlds } w \in h(p) : \text{MB}(w) \cap h(p') \neq \emptyset
\]

= \{ (g, h) \mid (g, h) \in [[p']] \land [z \land z \models \text{left}_{\text{card}_{p'}}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \}

\text{and there is no } h' \text{ s.t. } (g, h') \in [[p']] \land [z \ldots] \text{ and } h(p') \subseteq h'(p')
\]

\text{and for all worlds } w \in h(p) : \text{MB}(w) \cap h(p') \neq \emptyset
\]

\text{modal claim} \quad \forall w \in h(p') : h(x)(w) \in \mathcal{I}(\text{left}_{\text{card}})(w) \land h(x)(w) \neq \text{A\text{\textbullet}}

\text{non-at-issue imposition} \quad \forall w \in h(p^*) : h(x)(w) = \text{A\text{\textbullet}} \land \text{A\text{\textbullet}} \in \mathcal{I}(\text{left}_{\text{card}})(w)

This is the desired analysis. The modal claim comes down to the statement that it is possible that the card to the left is different from the ace of spades. The non-at-issue imposition states that the card to the left IS the ace of spades. Since the modal proposition \(p'\) and the non-at-issue imposition \(p^*\) are independent there is nothing contradictory about this arrangement – the modal claim is about a possibility while the non-at-issue imposition is about the pointing gesture in the actual state of affairs.

**Example 2: Demonstrative and Pointing in Modal Context.**

a.  \#It is possible that [this card] is not the ace of spades.

\text{POINTING TO A\textbullet}

b.  \[
\text{MIGHT}^\text{prop}_{p'} \left( [z \land z \models \text{card}_{p'}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \right)
\]

\[
\text{MIGHT}^\text{prop}_{p'} \left( [z \land z \models \text{card}_{p'}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \right)
\]

\[
= \{ (g, h) \mid (g, h) \in \max^{\text{prop}} [z \land z \models \text{card}_{p'}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \}
\]

= \{ (g, h) \mid (g, h) \in [[p']] \land [z \land z \models \text{card}_{p'}(x) \land x =_{p'} z \land \text{card}_{p'}(z) \land x \neq_{p'} \text{ace}_\text{of_spades} \}

\text{and for all worlds } w \in h(p^*) : h(x)(w) = \text{A\textbullet} \land h(x)(w) \neq \text{A\textbullet}
\]

\text{modal claim} \quad \forall w \in h(p^*) : h(x)(w) \in \mathcal{I}(\text{card})(w) \land h(x)(w) = \text{A\textbullet} \land h(x)(w) \neq \text{A\textbullet}

\text{non-at-issue imposition} \quad \forall w \in h(p^*) : \text{A\textbullet} \in \mathcal{I}(\text{card})(w)

In contrast to the definite case above the modal claim is contradictory. It requires the existence of an object with the property of being a card that is AND is not identical to the ace of spades. The non-at-issue imposition simply comes down to the statement that the ace of spades (the object pointed at) has the property of being a card. This accounts for the infelicity of this utterance.

Our notion of relativized identity is crucial for accounting for both examples. While the modal non-identity and gestural identity contribution contradict each other in Example 2, they do not interfere in the definite case as they are evaluated w.r.t. different propositions. In other words: while the mere act of pointing is one of rigid designation (i.e. across all possible worlds) this designation enters into propositional meanings on different dimensions. Overall this implements Kaplan’s insights.
On speakers in narrative fiction
Regine ECKARDT — Konstanz

Abstract. The paper investigates aspects of the contribution of indexicals to sentence meaning when the context, specifically the speaker, is unknown. One typical instance is the interpretation of the first person pronoun I in anonymous messages, another case are first and second person indexicals in narrative fiction. Whereas the speaker of an anonymous message can be found out, first speaker protagonists in fiction are a priori elusive. The paper argues that the meaning of indexicals in fiction and in anonymous utterances should be captured by forming the union over possible utterance contexts. It defines the subjective meaning for the hearer/reader as an appropriate level of semantic representation.

Keywords: context, Kaplan, indexicals, text.

1. Indexicals in fiction

Indexicals are expressions that must be interpreted relative to utterance context. The sentences in (1) are synonymous when uttered by Jim to Ada, but when uttered by Sally to Harry, they differ in meaning.

(1) a. Jim loves Ada.
    b. I love you.

In real utterance situations we commonly know who is speaking and who is the addressee. And even in the exceptional case that we receive an anonymous letter or send a message in the bottle, we can hope that facts in the actual world will eventually settle the utterance context, and with sufficient research or omniscience, the speaker or addressee can be determined. Texts of fiction radically differ from real utterances in this respect. When we read fictional texts, there is no external reality that determines the speaker behind the text. All the reader knows about the speaker is what is entailed by the text or can be inferred from it. The present paper explores how classical context theory can account for speakers in narrative fiction. It formalizes an earlier informal discussion of possible speaker constellations (Eckardt, 2015) and offers the foundations for Eckardt (2019/subm.), phrased in terms of classical (i.e., nondynamic) semantics.

Fictional texts can refer to speakers in various ways. First-person narratives rest on the use of I/me. They often provide extensive information about the speaker, sometimes but not always including the speaker’s name (for a first-person narrative told by a nameless person, see Haruki Murakami, The murder of the commendatore). The text can create the impression of a reliable speaker (Daniel Defoe, Robinson Crusoe), or of a speaker who is uninformed or deceptive (Mark Twain, Huckleberry Finn; Vladimir Nabokov, Lolita). Texts can also refer to the speaker in less obtrusive ways by using speaker-oriented expressions, commentary items, emotives, attitudes that the reader ascribes to the person telling the story (Harris and Potts, 2009, Eckardt, 2015).
Knut Hamsun’s *Growth of the Soil* provides an example of a text creating the fiction of someone telling the story, even though no first person pronoun ever refers to the teller. If we take into account the full range of indexicals in the broad sense, it becomes clear that a semantics of fictional texts has to capture what could be called “indefinite” speakers: The story creates the fiction that someone is telling it to me, the reader, but the text does not offer enough information to single out a specific person.

My starting point is Kaplan’s seminal analysis of indexicals (Kaplan, 1989) in the by now standard implementation developed by Zimmermann (1991, 2012).² Kaplan argued that sentences should be interpreted in two steps: First we have to resolve expressions that refer to the context, and only then should we compute the truth conditional content. The meaning of a sentence S must thus be represented by its character char(S), a function that maps utterance contexts $c$ to propositions. Utterance contexts are entities that give access to the parameters speaker, addressee, time, place and world. Specifically, Kaplan proposes the functions $sp$, $ad$, $time$, $loc$ and $world$ that map each context $c$ onto the respective $c$-parameter. Hence, $sp(c)$ is the person that counts as the speaker in $c$, and so on.

According to this analysis, sentence (1a) yields the same proposition for all contexts (disregarding utterance time), whereas sentence (1b) is context dependent.

(2) a. $\text{char(Jim loves Ada)} = \lambda c \lambda w \left[ \text{LOVE(Jim, Ada, w)} \right]$
    
    b. $\text{char(I love you)} = \lambda c \lambda w \left[ \text{LOVE(sp(c), ad(c), w)} \right]$

In a context with speaker Jim and addressee Ada, the two characters map to the same proposition $\lambda w \left[ \text{LOVE(Jim, Ada, w)} \right]$ and are thus synonymous. The opposition in (1) can be predicted. Generally, the utterance meaning of the sentence in context $c_i$ is derived by applying the character of S to $c_i$, as we see in (3).

(3) $\left[ [I\ love\ you]\right]^{c_i} = \lambda w \left[ \text{LOVE(sp(c_i), ad(c_i), time(c_i), w)} \right]$

Note that the world parameter is not instantiated by $c_i$; by assuming this, Kaplan ensures that we arrive at a proposition (set of worlds) rather than a truth value. In the course of the paper we will explore other ways to connect worlds and contexts.

Unknown contexts were mostly discussed in connection with utterances like *I am here now* in their “funny” sense, in which the sentence states that the speaker is now at the place of utterance. Although this reading is *a priory* true, the sentence can still be used in this way (Zimmermann, 1991, 2012). To capture the reading, Zimmermann proposes to derive the diagonal where context and world parameter are equated.

(4) $\text{Diagonal of ‘I am here now’}$
    
    $\triangleright= \lambda c [ \text{char(I am here now)(c)(c)} ]$
    
    $= \lambda c [ \text{IS-AT(sp(c), loc(c), time(c), world(c))} ]$

² For a more recent introduction, see also Schlenker (2018).
The proposal fleshes out a very vivid intuition: In a funny sense, the content of *I am here now* is true in any utterance context and the respective world. However, one ontological issue remains: What is the logical nature of propositions? Can propositions be sets of contexts, should they always be sets of worlds, or are the two domains the same? Several answers were pursued. Some authors resort to situation semantics where possible worlds are equated with possible situations, and thus, contexts could be integrated as a special type of situation (Kratzer, 1989, 2002, Barwise & Perry 1983, Barwise 1989). Others suggest to model contexts as centered worlds, i.e. a world with a pointer towards a specific utterance event (Stalnaker 2014, Ninan 2010), thus offering a different synthesis of world and context parameters. Independently of the advantages or disadvantages of these frameworks (see Eckardt subm.) I propose to leave intact the ontological separation of contexts $c$ and possible worlds $D$, and to resolve the issue in a different manner. The next section explores the *subjective utterance meaning* of sentence $S$ for interlocutors who lack information about the utterance context they are in.

### 2. Union over contexts

On Monday morning, Ada gets a note slipped under her office door. It says:

(5) I love you.

An utterance has been made. Ada is the addressee, but she does not know who wrote the note. Assuming that she trusts the utterance, she learns that “there is somebody who loves me (now, on Monday)”. How can we derive this?

Ada’s problem is that she does not know the utterance context $c$. While she knows some dimensions of her context, the speaker is open. Let $C_A$ be the set of contexts Ada could be in as far as she knows. It can be defined as in (6), where $Dox(A)$ are the the doxastic alternatives of Ada, i.e. the worlds that are compatible with Ada’s beliefs.

(6) $C_A := \{ c | c \in c \land world(c) \in Dox(A) \}$

To paraphrase: $c$ is a context such that the world in which $c$ takes place is compatible with what Ada knows. Among other things, she knows that somebody has just slipped the note (5) under her office door. In the given example, we can hence say more about $C_A$.

$$C_A = \{ c | c \in c \land ad(c) = Ada \land loc(c) = Ada’s \ office \land time(c) = Monday \land world(c) \in Dox(A) \}$$

Ada will interpret the sentence in (5) as a disjunction over all contents that could arise in one of the contexts she could be in. We use Kaplan’s mapping from character to propositions, as given in (7), to model the meaning of (5) for Ada. This is defined in (8), by forming the union over possible contexts.

---

3 The close match between context and world will be challenged in section 3 where I discuss the set of possible contexts in more detail.

4 This definition will have to be adjusted after the discussion of possible contexts below.
In the situation in (5) we derive the subjective meaning in (9). \( \text{LOVE}(x,y,t,w) \) is true iff \( x \) loves \( y \) at time \( t \) in world \( w \).

(9) Subjective meaning of S for Ada:
\[
\bigcup_{c \in CA} \lbrack S \rbrack^c = \bigcup_{c \in CA} \{ w \mid \text{LOVE}(sp(c), Ada, Monday, w) \text{ is true } \land \text{world}(c) \in \text{Dox}(Ada) \}
\]

This comes close to the set of possible worlds denoted by the sentence \textit{somebody loves Ada on Monday}, which is an appropriate result. There is yet an important difference. While the sentence \textit{somebody loves Ada on Monday} does not impose any restrictions on Ada’s lover, Ada only takes into account contexts that are compatible with what she believes otherwise. And Ada may know things that exclude certain persons as lovers. Say, her colleague Tim is obviously, ardently and exclusively in love with his new partner Sam. Hence, Ada knows that \( sp(c) \neq \text{Tim} \). Thus, for Ada the meaning of (5) is already restricted by what she knows, whereas the meaning of \textit{somebody loves Ada on Monday} is not restricted in this manner.

While Kaplan focused on the ideal case where the utterance context is known, real interlocutors often lack perfect knowledge. We therefore need what I will call the subjective meaning of the utterance for A. The proposition in (9) is the meaning of (5) for Ada when she receives the message (and assumes that she is the intended addressee). Analogously, speakers can make an utterance without being certain who the addressee will be. If shipwrecked Bob writes a message in the bottle saying \textit{I need your help!} he intends to convey \textit{Whoever finds this bottle, I need your help}. (10) reflects Bob’s interpretation of the sentence.

(10) \[
\bigcup_{c \in CB} \lbrack I \ need \ your \ help \rbrack^c = \bigcup_{c \in CB} \{ w \mid \text{NEED.HELP}(Bob, ad(c), time(c), w) \land \text{world}(c) \in \text{Dox}(Bob) \}
\]

Subjective meanings will become more useful when we turn to the interpretation of narrative fiction in section 4. Before doing so, it will be necessary to take a closer look at contexts and to reconsider Kaplan’s mapping from contexts to propositions.

3. Unions over contexts and kinds of contexts

The previous section considered the meaning of an utterance for individual A. Crucially, A could know something but not enough about the context to identify a single \( c \). Thus subjectivity enters semantic interpretation. The present section investigates union over sets of contexts \( c \) if all contexts are considered. This will allow for any constellation of speaker, addressee, time and place and thus abstracts away from particular doxastic backgrounds. Let \( c \) be the set of all contexts. (11) shows the meaning of note in (5), interpreted relative to \( C \).

(11) Character union over contexts:
\[
\bigcup_{c \in C} \text{char}(S)(c)
\]
This proposition can roughly be paraphrased as “someone loves someone at some time”, which is appropriate. However, a new question arises: Should the meaning of note (5) entail that (5) has actually been uttered? And if yes, how can we derive this?

In one sense, the meaning of a sentence $S$ should be independent of whether $S$ has been uttered. In this sense, the meaning of $S$ in (11) is appropriate. Yet it can be useful to think about the utterance meaning of sentence $S$ in situations where the dimensions of context $c$ (speaker, addressee, time and place) are unknown. For instance, when the reader interprets the meaning of sentences in a first-person narrator novel, the fiction includes not only that the protagonist did this or that, but also that she is telling the reader about it. Rewriting the text in third person will not yield the same story. Hence, we need a notion of utterance meaning of $S$ that is independent of whether the utterance context is known.

In order to define the utterance meaning of $S$, we must take a closer look at the set of contexts $C$. Formally, $C$ is a set of entities in the domain of the functions $sp$, $ad$, $time$ and $world$. The functions $sp$ and $ad$ map $C$ to $PERSON \subseteq D_p$, $time$ and $loc$ map $C$ to the domains of times and places, and $world: C \rightarrow D_w$. For any sentence $S$ and context $c$, $\text{char}(S)(c)$ is the meaning of $S$ if it were uttered in $world(c)$ by $sp(c)$ to $ad(c)$ and so on. Nothing so far ensures that the sentence is actually uttered in $world(c)$ by $sp(c)$. For some $c$, however, the $world(c)$ might incidentally contain an utterance event $e$ with $sp(c)$ the speaker, $ad(c)$ the addressee, at place $loc(c)$ and $time(c)$. Let us call such contexts realistic contexts. Contexts that are not realistic will be called counterfactual contexts.\(^5\)

(12) Definition: A context $c \in C$ is called realistic iff in $world(c)$ at $time(c)$ and $loc(c)$, an utterance takes place with speaker $sp(c)$ and addressee $ad(c)$. A context is called counterfactual if it is not realistic. Let $\text{Real.C} \subseteq C$ the set of realistic contexts and $\text{Cf.C}$ the set of counterfactual ones.\(^6\)

(13) Fact: $C = \text{Real.C} \cup \text{Cf.C}$

Returning to (11), we predict that the character union over all contexts could involve realistic as well as counterfactual contexts. The worlds of counterfactual contexts do not include a corresponding utterance event. Therefore, the proposition derived in (11) does not entail that the sentence was uttered in $world(c)$. If we define the utterance meaning of $S$ as in (14), however, we predict that an utterance took place.

(14) Utterance meaning of $S$:

\[
\bigcup_{c \in \text{Real.C}} [[S]]^c = \bigcup_{c \in \text{C Real}} \{ w \mid \text{LOVE}(sp(c), ad(c), time(c), w) \text{ is true } \}
\]

\[= \bigcup_{c \in \text{C Real}} \{ w \mid \text{LOVE}(sp(c), ad(c), time(c), w) \text{ is true } \land w = world(c) \}\]

---

\(^5\) The relation between utterance events and contexts is further highlighted in Eckardt (2015a).

\(^6\) In a refined version of the distinction, we could take the uttered sentence $S$ as another parameter of $c$. A context is realistic for sentence $S$ iff $c$ is realistic and $S$ is uttered in the respective speech event in $world(c)$.  

The union in (14) differs from (11) in two respects: First, we restrict the union to realistic contexts. Secondly, (14) states that the worlds in question are the worlds of the respective contexts. This part of the definition is reminiscent of Kaplan’s diagonalization in (4) (see Zimmermann 1991, 2012 for detailed discussion) but plays out slightly differently, as we will see below. Since we only consider realistic contexts, (14) entails that an utterance was made. If we restrict the range of contexts further to those being realistic for S, (14) can be paraphrased as in (15).

(15) Someone loves someone at some time and utters (5) to the person at the same time (and place).

Our analysis of first person narrative fiction in the next section will be based on the utterance meaning of S in (14). Before moving on, let us see how union over all contexts plays out when diagonalization is added. I will call this semantic object the counterfactual utterance meaning of S. (16) shows this union for example (5).

(16) Counterfactual utterance meaning (CUM) of (5)

\[ \bigcup_{c \in C} \{ w \mid LOVE(sp(c), ad(c), time(c), world(c)) \text{ is true} \land w=world(c) \} \]

This proposition can be paraphrased as “someone loves someone at some time, but possibly this hasn’t been said.” Is this the same as the character union in (11)? Not necessarily. Imagine a world \( w_{17} \) such that someone loves someone at some time in \( w_{17} \) but incidentally, C does not contain any context \( c \) with \( world(c)=w_{17} \). The world \( w_{17} \) is thus in the character union of (5) but not in CUM in (16). Hence the two sets are not identical. What seems to go wrong is that C misses a context that should be there. If we could ensure that \( c \) provides enough contexts, then \( (16) \) would be equivalent to (11), the union that is in accordance with Kaplan’s character. We therefore need a way to state that the set of contexts is “big enough”, which is achieved by the following definition.

(17) Definition: The set of contexts C in a model \( M \) with \( \text{PERSON} \subset D_e, \text{TIME} \subset D_t, \text{PLACE} \subset D_p \) and worlds \( D_s \) is complete iff for all tuples \( <a,b,t,p,w> \in \text{PERSON} \times \text{TIME} \times \text{PLACE} \times D_s \) there is a context \( c \in C \) such that \( sp(c)=a, ad(c)=b, time(c)=t, loc(c)=p \) and \( world(c)=w \).

This entails the following useful fact: If the set of contexts C is complete, then for any sentence S, the CUM of S is the same as the union over characters for S (as defined in (11)). Formally:

(18) If C is complete, then

\[ \bigcup_{c \in C} \{ w \mid \text{Char}(S)(c)(w) \text{ is true} \} \]

\[ = \bigcup_{c \in C} \{ w \mid \text{Char}(S)(c)(w) \text{ is true} \land w=world(c) \} \]

This means that if C is complete, then the CUM of S is just what the sentence conveys, abstracting away from which context it has been uttered. Only if we restrict attention to realistic contexts Real.C will the union over contexts derive a proposition that entails “S was also uttered”. The effect of diagonalization \( (w=world(c)) \) in definition (14) depends on the size of the set of contexts C. Neither the utterance meaning of S nor the counterfactual utterance
meaning CUM of S are subjective. In this they differ from the propositions we got when we asked *What does the note in (5) mean for Ada, the addressee?*

To sum up: Section 2 made use of union over contexts to derive the subjective meaning of utterances for a specific speaker or addressee. The present section demonstrates that union over contexts can also be used to define sentence meanings, abstracting away from the utterance context and still having a proposition (rather than a character, as in Kaplan’s definition). The semantic object in (14) provides for any sentence S the proposition \{ w | S is true in w and has been uttered in w \}.

The semantic objects in (11) and in (16) do not entail that S was uttered, but they are useful for a different reason. Both could be good candidates to avoid diagonalization in the traditional sense (i.e., equating contexts and worlds) and thereby also avoiding the ontological blurs that come along with it. Both give us the worlds in which the sentence is true, irrespective of whether it was uttered or not. Both could be good candidates for the meaning of *I am here now* in the sense of “somebody is at some place at some time”. Indeed, it turns out that the two semantic objects are identical if the set of contexts \(c\) is complete in the sense of (17).

Now that we better understand the impact of the “right” set of characters to be used in union over characters, let us briefly return to (6), which is the set of “contexts where Ada thinks she could be in”. We adapt the definition slightly, using the new terms introduced in the present section: Ada believes the content of the note (*I love you*) and moreover that someone told her so. In other words, Ada only takes contexts in Real.C into consideration, which leads to the set in (19).

\[
(19) \quad C_A = \text{the set of contexts Ada could be in, as far as she knows } \\
C_A := \{ c | c \in \text{Real.C \& world}(c) \in \text{Dox(A)} \} 
\]

(19) includes the condition that Ada only takes \(c \in \text{Real.C}\) into account and thus spells out what was implicit in definition (6) above. After all, \(\text{world}(c)\) is a world that coheres with Ada’s beliefs and she does believe that someone slipped her a note. (19) spells out that “having been said” is part of the subjective utterance meaning. This becomes more important when we now turn to fiction. While reading fiction, Ada has access to events and experiences reported in the text. Reading a first person narration is certainly an important part of that experience.

### 4. Fiction

#### 4.1 Truth in narrative fiction

Possible worlds are recognized as one of the basic entities in formal semantics, they are useful to model the meaning of modal and counterfactual statements (Lewis 1973). Lewis (1978) argues that they can also help to model texts of fiction. He proposes that fictional texts are interpreted as if the speaker told the story as true facts, thus extending the semantic analysis of assertions to a semantics for fiction.
The worlds we should consider, I suggest, are the worlds where the fiction is told, but as known fact rather than fiction. The act of storytelling occurs, just as it does here at our world; but there it is what here it falsely purports to be: truth-telling about matters whereof the teller has knowledge. (Lewis 1978: 266)

Lewis can thus generalize known techniques from assertive semantics to fiction. We continue to capture the content of sentences as propositions and to combine sentence meanings by intersection, thus deriving the content of the story (Stalnaker 1999, 2002, 2014). Adopting Lewis’ view, we also predict that the reader uses pragmatic mechanisms (implicatures) to enrich the content of sentences, which – as Lewis argues – puts the proposal in advantage over alternative semantic analyses of fiction. I adopt Lewis’ term teller in the following to refer to the role sp in the particular case of narrative fiction, and the reader R for ad. This reminds us of the special situation created by fiction; I do not mean to give up any of Kaplan’s assumptions about contexts and characters.

Lewis shows that sentences in narrative fiction do not update the reader’s belief worlds or the common ground of teller and reader. What is updated are the fictitious beliefs that reader R would have if the story was told as known fact. Let us call these worlds FICT(R,S) = the set of possible worlds that make the story S true, as interpreted by reader R. Lewis and later authors (Lewis 1978, 1980, Bonomi & Zucchi 2003, Matravers 2014) point out that FICT(R,S) is restricted by more propositions than those provided by the content of the story. Readers R add further plausible assumptions; for example a reader of a Sherlock Holmes story will add true facts about Britain (e.g., ‘cars drive on the left side of the road’) even if these are not stated in the novel explicitly. As these enrichments can depend on the reader’s knowledge, the account predicts that the meaning of narrative fiction is reader-dependent. The account allows that the author of the story never had any specific enrichments in mind. The author is not responsible for readers’ subjective interpretations and thus – as has been argued in literary theory – is not to be equated with the teller of the narration.

As a consequence, narrative fiction regularly presents us with the kind of utterance situation that we studied in the previous section. The fictitious situation of a teller talking plays a crucial part in the process of me interpreting the text, even as I do not yet know who the teller is. The teller can be a fictitious person (e.g., in homodiegetic, first-person narration) or altogether unknown, as in novels with an extra-heterodiegetic narrator (Pier 2016). The teller can use first person pronouns to refer to herself but can, alternatively, use indirect perspectivizing devices to make herself heard (Harris & Potts 2009, Eckardt 2015). Stories may also fail to provide a proper name to which the teller could be linked. And there is no external reality that identifies the teller. Narrative fiction must therefore be interpreted in terms of subjective meaning, as defined in the previous section.

4.2 Tellers: speakers in narrative fiction

Consider (20) from the first chapter of Mark Twain’s Huckleberry Finn.

(20) Tom and me found the money that the robbers hid in the cave, and it made us rich. We got six thousand dollars apiece—all gold.
The reader assumes a fictitious context where somebody called Huckleberry Finn asserts (20) as if it were a known fact. In terms of character union over contexts (11), the sentence conveys the following:

\[
\bigcup_{c \in \text{char}(S)} \{ w : \text{there is an } x \text{ such that } x \text{ and Tom found gold and } x \text{ and Tom are rich in } w \} \]

The proposition in (21) does not entail that the story has a teller who coincides with \( x \), nor that anyone uttered (20). Section 3 discussed how these entailments can be forced by restricting the union to realistic contexts Real.C.

\[
\bigcup_{c \in \text{Real.C}} \text{char}(S)(c) = \{ w : \text{there is an } x \text{ such that } x \text{ and Tom found gold, and } x \text{ and Tom are rich in } w, \\
\text{and } x \text{ is telling this in } w \} \]

(22) captures the “meaning of the sentence” as part of the unread novel (i.e. without any specific reader). The reader’s subjective interpretation when reading the novel is more informative: We must bring in the set of reader R’s possible contexts as defined in (19), repeated below.

\[
C_R = \{ c | c \in \text{Real.C} \land \text{world}(c) \in \text{Dox}(R) \} 
\]

As the doxastic alternatives of R do not support the content of fiction, we have to adjust the definition for the interpretation of narrative fiction. Let us first use Lewis’ insight that R has certain beliefs about worlds where the story could take place.

\[
\text{Fict(R)} = \{ w | \text{R believes that the story could take place in } w \} 
\]

Fict(R) serves the same function as R’s doxastic alternatives in the interpretation of assertive texts. As discussed in 4.1, Fict(R) is informed by general knowledge of R about world and time where the story is situated. — We can now define the context set C.FICTR as the set of utterance contexts that could, as far as R believes, be a context in which R reads the story as if it were told as known fact.

\[
\text{C.FICT}_R = \{ c | c \in \text{Real.C} \land \text{world}(c) \in \text{FICT}(R) \} 
\]

‘contexts that, as far as R believes, could be the context in which R is told the story’

Remember that Real.C does not say that \( c \) is part of the actual world. It ensures that the world of \( c \) contains a corresponding utterance at the right time and place and with the correct participants. If reader R views herself as the addressee of the first person narration, then R takes part as \( \text{ad}(c) \) in all \text{world}(c) in \text{C.FICT}_R. We can now define what the story (20) means for R. As before, I assume diagonalization: The world that the sentence talks about is the world in which the utterance context takes place (i.e., \( \square (20) \square (\text{world}(c)) \) is true).
(26) Utterance meaning of (20):
\[ \cup_{c \in \text{FICT-R}} \{ w \mid \text{world}(c) \land [\text{world}(c)](\text{world}(c)) \text{ is true} \} \]

The given example yields the following proposition.\(^7\)

(27) \[ \cup_{c \in \text{FICT-R}} \{ w \mid \text{sp}(c) \text{ and Tom found the money in world}(c) \land \text{sp}(c) \text{ and Tom became rich in world}(c) \land w=\text{world}(c) \} \]

= \{ w \mid \text{there is someone x such that x and Tom found gold} \land x \text{ and Tom became rich in w} \land x \text{ and R share a context in w as teller and hearer} \land w \text{ is a world where R thinks that the story takes place} \} \]

This final version spells out how R is involved in the world of the story where (20) is told as if it were a known fact. The semantic evaluation (26) also enriches the sentence content by R’s beliefs about the story settings. In the given case, R could be a reader who has already read *Tom Sawyer*. If so, then R will restrict possible worlds accordingly. The first sentence of *Huckleberry Finn* actually alludes to this possible background.

4.3 Deceptive and unreliable speakers

The reader-independent interpretation defined in (22) might suggest that the teller has unchallenged authority on the content of the story. This is problematic, as it has been pointed out that tellers can be unreliable or even deceptive. The subjective interpretation can account for such constellations. Let us look at the following (hypothetic) utterance of Huckleberry Finn as part of the novel.

(28) The priest was wearing a cozy.

If (28) were part of the story told, the reader would rather assume that Huck is mistaken about the nature of clerical headgear than believe that a priest had a coffee warmer on his head. The unfiltered subjective interpretation would therefore produce the empty set:

(29) \[ \cup_{c \in \text{FICT-R}} \{ w \mid \text{the.priest wore a cozy in world}(c) \land w=\text{world}(c) \} \]

= \{ w \mid \text{the.priest wore a cozy in world}(c) \land x \text{ and R are engaged in w as teller and hearer} \land w \text{ is a world where R thinks that the story takes place} \} \]

= \emptyset

The reader R must react to the fact that the story content now is contradictory. Like in real-world communication, R will conduct a meta-linguistic plausibility check. She takes into account her knowledge about the protagonist, for instance that Huck is not acquainted with or interested in traditional religious practices. She assumes that Huck does not aim to ridicule the

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\(^7\) I leave the definite NPs unresolved.
reader but aims to use what he believes to be the proper word for the thing he saw. In brief, R
is trying to reconstruct worlds \( w \) that could be described by Huck in this way and plausibly be
worlds where the story holds true. I will not investigate the necessary belief revisions in detail,
but see (Maier & Semeijn, 2019/subm.) for similar cases.

While the error in (28) was easy to detect, other unreliable tellers require more knowledge of
the human nature to be unmasked. The reader’s questioning the truth of the teller’s statements
as part of the given fiction rests substantially on what the reader learned about the teller in the
preceding story. Interpretation rests on the fact that the reader equates \( sp(c) \) with the protagonist
\( x \) in the story.\(^8\) In the classical semantic framework we used so far the equation will need
auxiliary descriptions such as \( \textsc{the.speaker}(x) \) in order to mirror the status of \( x \) independently
of the contexts in \( \textsc{c.fict}_R \). A dynamic semantic framework could facilitate the task of tracking
the teller and equating him with a protagonist.

5. Going dynamic

This section addresses an unwelcome asymmetry that we inherit from Kaplan’s framework.
His character theory does not treat all context parameters alike: The context determines
speaker, addressee, place and time, but the world parameter is left aside, which allows Kaplan
to derive propositions (see (2),(3)). The present paper explores an analysis that alleviates this
asymmetry: The subjective meaning account assumes that the sentence predicates about
\( \textsc{world}(c) \). While this predicts that all context parameters contribute to meaning in a uniform
manner, one may still have the feeling that the world parameter is not treated like all other
parameters. While all context parameters play out in computing the sentence meaning, only the
world parameter \( \textsc{world}(c) = w \) determines the objects we sum up. This is needed to ensure that
the definitions in (8), (9), (11) and all following derive sets of worlds, not sets of contexts.

The asymmetry can be resolved if we transfer the present definitions into a dynamic semantic
framework (Kamp 1981, Heim 1982, Groenendijk & Stockhof 1990, a.o.). These frameworks
have in common that sentences essentially denote sets of variable assignments instead of sets
of worlds (van Leusen & Muskens 2003 make this point most clearly). Variables \( x_1, x_2, \ldots, x_i \)
represent discourse referents, and for each assignment \( f \) the value \( f(x_i) \) is one of the entities
that \( x_i \) could refer to. These sets of assignments show up in different notations (as DRS boxes,
as sets of files, as pairs of assignments etc.) which blurs the commonalities of theories.
Sentence meanings in dynamic semantics boil down to sets of assignment functions; or in other
words, sets of tuples of objects.\(^9\) This framework allows us to integrate other context
parameters into the meaning of sentences. Let us return to the beginning of Huckleberry Finn.

(30) Tom and me found the money that the robbers hid in the cave, and it made us rich.

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\(^8\) The ultimate challenge for any theory are narratives where the reader only in \textit{retrospect} will understand that the
teller was unreliable early on. Such narratives require a second reading by necessity (see \textit{Mottenlicht} by Antje
Wagner for an example). I leave a detailed discussion of such cases aside.

\(^9\) Whether finite or infinite tuples serve the purpose, was a hotly debated issue in early dynamic literature. Both
assumptions lead to a consistent theory and I will talk in terms of finite tuples, for the sake of simplicity.
If analysed in DRT, the sentence introduces the following discourse referents: \( x_1 \) for ‘Tom’, \( x_2 \) for the referent of ‘me’, \( x_3 \) for ‘the money’, \( x_4 \) for ‘the robbers’ and \( x_5 \) for ‘the cave’. The sentence meaning will be tantamount to the set of all variable assignments \( f \) that map \( f(x_i) \) to the person called Tom (and having the Tom-properties of volume 1), \( f(x_2) \) to the speaker \( sp(c) \), \( f(x_3) \) to ‘the money’ and so on. All context parameters that are explicitly introduced by words (I, you) or other expressions (luckily, Alas!) introduce a discourse referent. Being mirrored by the semantic representation is no longer the privilege of possible worlds. A dynamic rendering of narrative text also records teller, reader (if mentioned) and other indexical parameters.

Let me stress a last time that the present account cannot be replaced by Kaplan’s classical characters, evaluated in single contexts \( c \). Kaplan predicts that \( sp(c) \) is always the one and same person named Huck Finn in all possible worlds. Yet, speakers in narrative fiction cannot generally be captured by stipulating a single teller \( T \) that acts in all possible worlds where the story is true. There are first person stories (or passages in the beginning) where the speaker’s name is unknown and speaker identity open: Someone is telling you this. Examples include not only anonymous first person narrations like Murakami, *The murdering of the commendatore*, but also implicit first person tellers as in Knut Hamsun’s *Soil of the Earth*.\(^\text{10}\) This kind of story meaning, at the latest, rests on union over possible utterance contexts and the auxiliary notions in sections 2 – 4. In a potential dynamic representation we will not only consider the union over context worlds but also include context speakers, context times, context places and possibly context addressees.\(^\text{11}\) Dynamic semantics thus offers a symmetric treatment for all context parameters, levelling out the asymmetry between world and other. I will not provide the dynamic version of the analysis here, but see Eckardt (2019/subm.) for an extension in this direction.

### 6. Summary

Kaplan’s interpretation of indexicals rests on the basic assumption that speaker and addressee know each other in normal utterance situations. His step from character to proposition offers a systematic interpretation of indexicals in truth conditional semantics. The analysis is challenged by examples where the hearer has incomplete information about the context. Our main examples were the anonymous message and the message in the bottle. I proposed that the proposition conveyed is computed by summing over all utterance contexts \( c \) that the addressee holds possible. Section 3 argued that the union over contexts offers an alternative way to derive propositions from characters, and showed how these semantic objects depend on the overall set of contexts \( C \). \( C \) and its subsets must be carefully controlled for in order to predict adequate denotations of sentences. This was an important prerequisite for investigating the meaning of fiction.

Section 4 turned to the analysis of fiction. Following the lead of Lewis, I generalized notions like doxastic alternatives, possible contexts and subjective meaning to the domain of fiction. We arrived at a definition of what sentences in fiction mean for readers, bringing in their beliefs about the story worlds and the content of the text. The analysis can also capture anonymous

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\(^{10}\) See Eckardt (2019/subm.) for extended discussion of examples and speaker-oriented items in fiction.

\(^{11}\) Epistolary novels like Goethe’s *Werther* create the fiction that the teller is talking to the letters’ addressee, not the reader.
tellers of stories and deal with unreliable and deceptive tellers. Section 5 proposed some potential advantages of re-setting the analysis in a dynamic semantic framework.

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Source text

Licensing free choice *any* on an existential semantics for imperatives
Naomi FRANCIS — Massachusetts Institute of Technology

**Abstract.** This paper seeks to explain why free choice *any* is licensed in strong imperatives and weak imperatives but not under strong modals. It argues that this contrast can be accounted for on the assumption that, instead of a strong (universal) modal, strong imperatives contain a weak (existential) modal that is strengthened by exhaustification (Schwager, 2005; Oikonomou, 2016). On this view, strong and weak imperatives have an identical structure at the point where the licensing of *any* is checked.

**Keywords:** imperatives, free choice, *any*, strengthening.

1. The puzzle

Free choice is a strengthening effect that is available in modal environments. For example, the meaning of the sentence in (1) predicted from the meaning of disjunction and the meaning of the existential modal is the disjunction of modalized propositions given in (1a), but native speakers routinely infer the stronger conjunctive meaning in (1b). Similar facts hold for free choice *any*, as shown in (2), since existential quantification is equivalent to disjunction over the domain of the quantifier.

(1) You may read book 1 or book 2.
   a. You may read book 1 or you may read book 2. ♦(read b₁ ∨ read b₂)
   b. You may read book 1 and you may read book 2. ♦(read b₁) ∧ ♦(read b₂)

(2) You may read any book.
   ♦(∃b ∈ D[b₁,b₂]: you read read b) = ♦(read b₁) ∨ ♦(read b₂)
   a. You may read book 1 or you may read book 2. ♦(read b₁) ∨ ♦(read b₂)
   b. You may read book 1 and you may read book 2. ♦(read b₁) ∧ ♦(read b₂)

Free choice *any* has a restricted distribution; it is licensed under existential modals but not under universal modals or in unembedded environments.

(3) Licensing of *any* in declaratives
   a. You may read any book.
   b. #You must read any book.
   c. #Sam read any book (yesterday).

There is an exception to this generalization, namely the phenomenon known as subtrigging (Dayal, 1998). Subtrigging is a process whereby modification of the *any* phrase renders it acceptable in environments where it would normally be ruled out, as shown in (4).

(4) Subtrigging
   a. You must read any book that won a prize. ♦(read b₁) ∨ ♦(read b₂) cf. (3b)
   ~# You must read every book that won a prize

---

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b. Sam read any book that won a prize.  
\[\sim \text{Sam must read every book that won a prize}\]  

Crucially, the felicitous readings yielded by subtrigging are not free choice readings; they have a universal flavour.

Like modals, imperatives vary in force; they have both strong (e.g., command; \(\Box\)) and weak (e.g., acquiescence, indifference; \(\Diamond\)) readings, illustrated in (5) and (6)-(7), respectively.

(5) [Parent, to child:] Eat! \(\Box_{\text{imp}}\)

(6) a. Is it alright if I eat?  
b. Sure, go ahead! Eat! \(\Diamond_{\text{imp}}\)

(7) a. I can’t decide whether to eat or not.  
b. Eat! Don’t eat! I don’t care. \(\Diamond_{\text{imp}}\)

However, unlike modals, free choice any is licensed in imperatives regardless of their strength (Giannakidou 2001; Aloni 2007; Kaufmann 2012, pace Strickland 1982; Haspelmath 1997). This is illustrated by the felicity of both the weak imperative in (8) and the strong imperative in (9).

(8) a. May I read a book?  
b. Sure! Read any book! \(\Diamond_{\text{imp}}(b_1) \land \Diamond_{\text{imp}}(b_2)\)

(9) a. How do I get into your book club?  
b. Read any book! \(\Box_{\text{imp}}(b_1 \lor b_2) \land \Diamond_{\text{imp}}(b_1) \land \Diamond_{\text{imp}}(b_2)\)

It should be noted that the acceptability of the strong imperative in (9) is not due to subtrigging; as with modals, subtrigging is available for imperatives but yields a universal reading, as in (10).

(10) Read any book that won a prize! \(\Box_{\text{imp}}(b_1) \land \Box_{\text{imp}}(b_2)\)  
\[\sim \text{Read every book that won a prize!}\]

In contrast, the strong imperative in (9) conveys a command to read a book (i.e., to read book 1 or book 2) but leaves the choice of which book to read up to the addressee; crucially, (9) does not require the addressee to read every book in the domain (see Giannakidou 2001; Aloni 2007; Kaufmann 2012).

The goal of this paper is to explain the distribution of free choice any in modal and imperative environments, summarized in (11).

(11) Distribution of free choice any  
a. \(\Diamond_{\text{mod}}[...\text{any}...]\)  
b. \(#\Box_{\text{mod}}[...\text{any}...]\)  
c. \(\Diamond_{\text{imp}}[...\text{any}...]\)  
d. \(\Box_{\text{imp}}[...\text{any}...]\)

To do this, we will need to find something that strong imperatives have in common with weak imperatives and weak modals, to the exclusion of strong modals. This paper will argue that the distribution in (11) can be explained if we assume that strong imperatives, unlike strong modals, contain the structure of their weak counterparts. The solution that I propose was independently
suggested by Luka Crnič in an early draft of what became Crnič (2017), although it does not appear in the published version of that paper. In the end, we will see that existing machinery, when combined correctly, derives the attested distribution of free choice any.

The remainder of this paper is structured as follows: Section 2 will describe the assumptions that will be made about free choice, any, and imperatives; Section 3 will show how putting these tools together yields the desired result; Section 4 considers implications of the proposal for our theory of imperatives, and Section 5 concludes.

2. Toolkit

2.1. Assumptions about free choice

I will assume that free choice effects are derived by exhaustification over subdomain alternatives (Fox, 2007). I will assume the implementation of this idea proposed by Bar-Lev and Fox (2017), where strengthening is performed by a covert operator, exh, with the meaning in (12).²

\[
\text{exh}_{C}^{\text{w}} = \lambda C_{(s,t)} \cdot \lambda p_{(s,t)} : \forall q \in \text{II}(p, C) [q(w)] \text{ and } \forall r \in \text{IE}(p, C) [\neg r(w)]
\]

where IE(p,C) is the set of innocently excludable alternatives for p in C and II(p,C) is the set of innocently includable alternatives for p in C

According to this denotation, exh takes as two arguments: its prejacent (p) and a set of alternatives (C), which is here stipulated to contain the propositions formed by replacing the domain of the weak scalar element in p (i.e., disjunction or existential quantifier) by subsets of the original. The innocently excludable alternatives for p in C (IE(p, C)) are defined as the largest non-arbitrary set of alternatives that can be jointly negated without contradicting the prejacent, while the innocently includable alternatives for p in C (II(p, C)) are the largest non-arbitrary set of alternatives that can be jointly negated without contradicting the conjunction of the prejacent with the negation of the innocently excludable alternatives. Exh’s contribution is to negate all of the innocently excludable alternatives and assert all of the innocently includable alternatives.

When applied to a sentence like You may read any book, Bar-Lev and Fox’s (2017) system derives the free choice reading by having this exh i) associate with the existential quantifier and its domain as in (13a) and ii) consult the set of alternatives in (13b), for a toy world containing only two books.³

\begin{align*}
(13) \quad \text{You may read any book.} \\
\text{a. } \text{LF} &= [\text{exh}_{C_{1}} [\diamond \{\text{you read a}_{\{b_{1}, b_{2}\}}^{} \text{ book}]])] \\
& \quad \diamond \{\text{you read a}_{\{b_{1}\}}^{} \text{ book}], \quad \text{II} \\
& \quad \diamond \{\text{you read a}_{\{b_{2}\}}^{} \text{ book}], \quad \text{II} \\
& \quad \diamond \{\text{you read every}_{\{b_{1}, b_{2}\}}^{} \text{ book})] \quad \text{IE}
\end{align*}

²This denotation differs from the one provided by Fox (2007) in that, in addition to negating the innocently excludable alternatives, exh asserts the innocently includable alternatives. A single application of Bar-Lev and Fox’s (2017) innocent inclusion exh has the same effect as two applications of Fox’s (2007) innocent exclusion exh.

³The bracketed alternative in (13b) is sometimes called a scalar alternative to distinguish it from the subdomain alternatives (see Chierchia 2013). This alternative may be pruned; if it is not, a prohibition on reading both books will be generated.
In this case, only the strongest alternative, shown in brackets in (13), is innocently excludable; the others are innocently includable. This means that \textit{exh} will negate the former and assert the latter, as in (14).

\begin{equation}
\text{exh}(C_1)(\Diamond \text{ you read } a_{\{b_1,b_2\}} \text{ book}) = 1 \iff \Diamond \text{ you read } a_{\{b_1, b_2\}} \text{ book } \\
\land \Diamond \text{ you read } a_{\{b_1\}} \text{ book } \\
\land \Diamond \text{ you read } a_{\{b_2\}} \text{ book } \\
(\land \neg \Diamond \text{ you read } b_{\{b_1, b_2\}} \text{ book })
\end{equation}

The resulting conjunction of the innocently includable alternatives yields the free choice inference that both the reading of book 1 and the reading of book 2 are permitted.

2.2. Assumptions about \textit{any}

The distribution of \textit{any} is restricted in a way that is independent of its free choice status: sentences with \textit{any} must make a stronger contribution than sentences with a plain indefinite such as \textit{a} (Kadmon and Landman, 1993; Lahiri, 1998). Following Chierchia (2013), Crnič (2017), and others, I will derive this restriction by embedding the basic free choice structure under a covert \textit{even}-like operator; like \textit{exh}, this operator will associate with \textit{any} and act on its subdomain alternatives. I will assume that this covert operator (represented as \textit{EVEN} to distinguish it from its overt counterpart) is like English \textit{even} in having a scalar presupposition requires that its prejacent less likely, more noteworthy, or otherwise stronger than its its alternatives; this will ensure that free choice \textit{any} is only licensed when its free choice inference strengthens the meaning of the sentence that contains it. I will remain agnostic about whether \textit{EVEN} also carries an additive presupposition, as \textit{even} does.

To see how this correctly derives the distribution of free choice \textit{any}, let us work through three examples. Firstly, let us confirm that this machinery derives the acceptability of a weak modal statement like \textit{You may read any book}. Assuming the structure in (15a), the prejacent of \textit{EVEN} is identical to the free choice structure in (13a); the free choice effect is derived as in (14) using the alternatives in (15c). The alternatives that \textit{EVEN} operates on are those in (15c).

\begin{equation}
\text{(15) You may read any book.} \\
\text{a. LF = EVEN}_{C_2} \left[ \Diamond \text{ [you read } a_{\{b_1,b_2\}|F_1, F_2} \text{ book]} \right] \\
\text{b. } C_1 = \left\{ \begin{array}{ll}
\Diamond \text{ [you read } a_{\{b_1, b_2\}} \text{ book]}, & \text{II} \\
\Diamond \text{ [you read } a_{\{b_1\}} \text{ book]}, & \text{II} \\
\Diamond \text{ [you read } a_{\{b_2\}} \text{ book]}, & \text{II} \\
(\Diamond \text{ [you read every } b_{\{b_1, b_2\}} \text{ book}]) & \text{IE}
\end{array} \right\} \\
\text{c. } C_2 = \left\{ \begin{array}{ll}
\text{exh}_{C_1} \left[ \Diamond \text{ [you read } a_{\{b_1, b_2\}|F_1} \text{ book]} \right], & \\
\text{exh}_{C_1} \left[ \Diamond \text{ [you read } a_{\{b_1\}|F_1} \text{ book]} \right], & \\
\text{exh}_{C_1} \left[ \Diamond \text{ [you read } a_{\{b_2\}|F_1} \text{ book]} \right] &
\end{array} \right\}
\end{equation}

Let us assume that i) within each of the alternatives in (15c) the value of \( C_1 \) is calculated independently, and ii) the substitutions that \textit{EVEN} makes in building its alternative set are the same as those used by \textit{exh} (i.e., subdomains of the existential quantifier). We have already

\footnote{It may be necessary to restrict the flavour of \textit{even}'s scale to entailment; see discussion in Crnič 2017.}

\footnote{The presentation here closely follows that in Crnič (2017).}
seen that the interpretation of the first alternative in (15c) (i.e., the prejacent of EVEN) is the conjunction of the first three alternatives in (15b). Since the domain of the existential quantifier in the prejacent of \textit{exh} in the second and third alternatives in (15c) is a singleton set containing just one book, there are no subdomain alternatives for \textit{exh} to consider. All it can do in each of these cases, then, is assert its prejacent, which is by definition innocently includable. The alternatives in (15c) are thus equivalent to (16).

\begin{equation}
C_2 = \begin{cases}
\Diamond \text{[you read } a_{\{b_1,b_2\}\text{ book}] } \\
\Diamond \text{[you read } a_{\{b_1\}\text{ book}] } \\
\Diamond \text{[you read } a_{\{b_2\}\text{ book}] }
\end{cases}
\end{equation}

The prejacent of \textit{EVEN}, which is equivalent to the first alternative in (16), entails both of the other alternatives. Thus, the scalar presupposition of \textit{EVEN} is satisfied, and \textit{any} is correctly predicted to be licensed.

Next, let us consider the unacceptability of \textit{#You must read any book}, where \textit{any} is embedded under a strong modal. This sentence will have the structure in (17a).

\begin{equation}
\text{(17) } \#\text{You must read any book.}
\end{equation}

\begin{enumerate}
\item \textit{LF} = \text{EVEN}_{C_2} [\Box \text{[you read } a_{\{b_1,b_2\}\text{ book}] }]
\item \text{C}_1 = \begin{cases}
\Box \text{[you read } a_{\{b_1,b_2\}\text{ book}] } \\
\Box \text{[you read } a_{\{b_1\}\text{ book}] } \\
\Box \text{[you read } a_{\{b_2\}\text{ book}] } \\
(\Box \text{[you read every } \{b_1,b_2\}\text{ book] })
\end{cases}
\item \text{C}_2 = \begin{cases}
\text{exh}_{C_1} \Box \text{[you read } a_{\{b_1,b_2\}\text{ book}] }, \\
\text{exh}_{C_1} \Box \text{[you read } a_{\{b_1\}\text{ book}] } \\
\text{exh}_{C_1} \Box \text{[you read } a_{\{b_2\}\text{ book}] }
\end{cases}
\end{enumerate}

It is perfectly consistent for one to be required to read a book without being required to read any particular book; this is, after all, what it means to have free choice. All of the non-prejacent alternatives in (17b) are therefore innocently excludable and hence negated by \textit{exh} as in (18).

\begin{equation}
exh(C_1)(\Box \text{ you read } a_{\{b_1,b_2\}\text{ book}}) = 1 \text{ iff } \Box \text{ you read } a_{\{b_1,b_2\}\text{ book}} \end{equation}

\begin{enumerate}
\item \Box \text{ you read } a_{\{b_1,b_2\}\text{ book}} \\
\Box \text{ you read } a_{\{b_1\}\text{ book}} \\
\Box \text{ you read } a_{\{b_2\}\text{ book}} \\
(\Box \text{ you read every } \{b_1,b_2\}\text{ book})
\end{enumerate}

The alternatives that \textit{EVEN} applies to in (17c) will thus have the meanings in (19).

\begin{equation}
C_2 = \begin{cases}
\Box \text{[you read } a_{\{b_1,b_2\}\text{ book}] } \\
\Box \text{[you read } a_{\{b_1\}\text{ book}] } \\
\Box \text{[you read } a_{\{b_2\}\text{ book}] }
\end{cases}
\end{equation}

The prejacent of \textit{EVEN}, corresponding to the first alternative in (19), is not in an entailment relation with the other alternatives. The scalar presupposition is therefore not guaranteed to

\footnote{I omit the contribution of the scalar alternative in the prejacent for the sake of space.}
be satisfied, and would in fact require a peculiar context to be satisfied. Furthermore, if this covert even is like the overt even in having an additive presupposition, this presupposition will not be satisfiable, because the prejacent entails the negation of both non-prejacent alternatives. We therefore predict #You must read any book to be infelicitous, as desired.

Finally, let us see how this approach derives the unacceptability of unembedded free choice any, as in #Sam read any book (yesterday).

(20) #Sam read any book (yesterday).
   a. LF = EVENC₂ [exhC₁ [Sam read aₐ₁b₂F₁F₂ book]]
   b. C₁ = { [Sam read aₐ₁b₂ book],
                [Sam read aₐ₁b₂ book],
                ([Sam read everyₐ₁b₂ book]) }
   c. C₂ = { exhC₁ [Sam read aₐ₁b₂F₁ book],
                exhC₁ [Sam read aₐ₁b₂F₁ book],
                exhC₁ [Sam read aₐ₁b₂F₁ book] }

Here, in the absence of a modal, the alternatives for exh are simply quantificational statements ranging over different domains of books. The prejacent will be innocently includable and the conjunctive alternative will be innocently excludable, as before, but now the alternatives where the quantifier ranges over singleton books are neither includable nor excludable. They will therefore be neither negated nor asserted by exh, as shown in (21).

(21) exh(C₁)(Sam read aₐ₁b₂ book) = 1 iff you read aₐ₁b₂ book

   (∧ ¬ Sam read everyₐ₁b₂ book)

The alternatives that even considers will have meanings equivalent to the following:

(22) C₂ = { Sam read aₐ₁b₂ book (∧ ¬ Sam read everyₐ₁b₂ book),
                Sam read aₐ₁b₁ book,
                Sam read aₐ₁b₁ book }

Here, the prejacent (which corresponds to the first alternative in (22)), is entailed by the other alternatives. Thus, the scalar presupposition of even is not satisfied, and so we correctly predict this sentence to be unacceptable.

2.3. Assumptions about imperatives

I will assume that imperatives contain a covert modal operator in their left periphery (Schwager 2006/Kaufmann 2012, i.a.). On this view, an imperative like Read! means something very similar to You must read;8 presuppositions ensure that the imperative modal can only be read performatively, and not as a simple description of the addressee’s obligations.

7The relevant context would be one where it is less likely that the addressee is required to read some book and given free choice as to which one than that the addressee is required to read book 1, and likewise it is less likely that the addressee is required to read some book and given free choice as to which one than that the addressee is required to read book 2. If even’s scalar presupposition was restricted to an entailment-based scale, this presupposition would simply be unsatisfied here.

8The imperative operator is a root modal related to obligations, preferences, desires, or goals.
I will assume that the force of this modal operator is underlyingly weak (♦), with strong readings derived by exhaustification (Schwager, 2005; Oikonomou, 2016). There are several ways of cashing out this idea formally; here, I will assume that strengthening is achieved by exhaustifying over subdomains of the imperative modal, much like the free choice strengthening discussed above. This approach mirrors that of Bassi and Bar-Lev (2016) in their account of bare conditionals as underlyingly existential modals.

For a toy context containing just two accessible worlds, w1 and w2, the strong reading the imperative Read! will be derived by assuming the structure in (23a) and the alternatives in (23b).

(23) Read!

a. LF: exhC1 [♦{w1,w2} [you read]]

b. C1 = {[♦{w1} [you read]], [♦{w2} [you read]]}

II

The non-prejacent alternatives in (23b) are weak modal statements quantifying over singleton sets of worlds. Asserting that there is a world in a set containing just one world where you read is equivalent to asserting that you read in that world. This makes each of the non-prejacent alternatives stronger than the prejacent, but neither of them can be negated without entailing the other – that is, neither of them is innocently excludable. All of the alternatives in (23b) are innocently includable, and so the interpretation of (23) will be as in (24). Crucially, thanks to the latter two alternatives, this conjunction entails that each of the worlds in the modal’s domain is a world in which you read. This is equivalent to universal quantification over the accessible worlds: a □ meaning.

(24) \(exh(C_1)(\diamond_{\{w_1,w_2\}} \text{ you read}) = 1 \iff \diamond_{\{w_1,w_2\}} \text{ you read} \land \diamond_{\{w_1\}} \text{ you read} \land \diamond_{\{w_2\}} \text{ you read} = 1 \iff \Box_{\{w_1,w_2\}} \text{ you read}\)

It is important to note that the procedure just described can only strengthen an existential modal if it lacks a universal dual (Oikonomou, 2016; Bassi and Bar-Lev, 2016). If C1 contained \(\Box_{\{w_1,w_2\}} \text{ you read} – the counterpart of the bracketed alternative in (15b) – the alternative in question would be innocently excludable. Because the conjunction of \(\diamond_{\{w_1\}} \text{ you read} and \diamond_{\{w_2\}} \text{ you read} is inconsistent with the negation of \(\Box_{\{w_1,w_2\}} \text{ you read}, the former alternatives would no longer be innocently includable. The result of applying exh to this four-membered set of alternatives would be therefore be the conjunction of the prejacent with the negation of the universal alternative (i.e., the conjunction \([\diamond_{\{w_1,w_2\}} \text{ you read} \land \neg \Box_{\{w_1,w_2\}} \text{ you read}])\).

3. Proposal

To capture the distribution of any, all that is needed is to combine the tools outlined in the previous section. Assuming that the imperative operator is underlyingly an existential modal, with strong readings derived by the application of exh, allows us to replace the distribution of free choice any from (11) with (25).
Distribution of free choice *any* (revised)

- ♦_{\text{mod}}[*any*...]
- #□_{\text{mod}}[*any*...]
- ♦_{\text{imp}}[*any*...]
- exh ♦_{\text{imp}}[*any*...]

It is now clear what the relevant difference between strong modal statements and strong imperatives is: only the former contains a universal modal operator. In contrast, weak modals, weak imperatives, and strong imperatives all contain an existential modal operator.\(^9\)

We have already seen how existing tools derive the acceptability of free choice *any* in weak modal statements. The acceptability of free choice *any* in weak imperatives follows in exactly the same way; the LF and alternative sets in (26) are identical to those in (15).

(26) Read any book! \(\Diamond_{\text{imp}}\)

- **a.** LF = \(\text{EVEN}_{C_2} [\text{exh}_{C_1} [\Diamond [\text{you read } a_{(b_1,b_2)F_1,F_2}\text{ book}]]] \)
- **b.** \(C_1 = \{\)
  - \(\Diamond [\text{you read } a_{(b_1,b_2)}\text{ book}], \)
  - \(\Diamond [\text{you read } a_{b_1}\text{ book}], \)
  - \(\Diamond [\text{you read } a_{b_2}\text{ book}], \)
  - \(\Diamond [\text{you read every } (b_1,b_2)\text{ book}] \)

- **c.** \(C_2 = \{\)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{(b_1,b_2)F_1}\text{ book}]], \)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{b_1}\text{ book}]], \)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{b_2}\text{ book}]] \)

Just like a weak modal statement, this imperative states that the addressee is permitted to read book 1 and permitted to read book 2, as shown in (27) (cf. (15)).

(27) \(\text{exh}(C_1)(\Diamond \text{you read } a_{(b_1,b_2)}\text{ book}) = 1 \text{ iff } \Diamond \text{you read } a_{(b_1,b_2)}\text{ book} \land \Diamond \text{you read } a_{b_1}\text{ book} \land \Diamond \text{you read } a_{b_2}\text{ book} \land \neg \Diamond \text{you read every } (b_1,b_2)\text{ book} \)

To capture the acceptability of free choice *any* in strong imperatives, all that is needed is to assume that the *exh* that strengthens the imperative operator is located above the *exh* that derives free choice and the covert *EVEN* that checks *any*’s licensing condition. This will ensure that strong imperatives with *any* contain the structure of their weak counterparts; this is shown in (28a), where the underlined portion of the structure is identical to the structure in (26a).

(28) Read any book! \(\Box_{\text{imp}}\)

- **a.** LF: \(\text{exh}_{C_3} [\text{EVEN}_{C_2} [\text{exh}_{C_1} [\Diamond_{(w_1,w_2)F_3} [\text{you read } a_{(b_1,b_2)F_1,F_2}\text{ book}]]]] \)
- **b.** \(C_1 = \{\)
  - \(\Diamond [\text{you read } a_{(b_1,b_2)}\text{ book}], \)
  - \(\Diamond [\text{you read } a_{b_1}\text{ book}], \)
  - \(\Diamond [\text{you read } a_{b_2}\text{ book}], \)
  - \(\Diamond [\text{you read every } (b_1,b_2)\text{ book}] \)

- **c.** \(C_2 = \{\)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{(b_1,b_2)F_1}\text{ book}]], \)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{b_1}\text{ book}]], \)
  - \(\text{exh}_{C_1} [\Diamond [\text{you read } a_{b_2}\text{ book}]] \)

\(^9\)As noted in Section 1, the analysis presented here was independently proposed by Luka Crnić.
 Licensing free choice any on an existential semantics for imperatives

\[ C_3 = \left\{ \begin{array}{ll}
\text{EVEN}_{C_2} \left[ \text{exh}_{C_1} \left[ \Diamond_{\{w_1,w_2\}} \left[ \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \right] \right] \right], \\
\text{EVEN}_{C_2} \left[ \text{exh}_{C_1} \left[ \Diamond_{\{w_1\}} \left[ \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \right] \right] \right], \\
\text{EVEN}_{C_2} \left[ \text{exh}_{C_1} \left[ \Diamond_{\{w_2\}} \left[ \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \right] \right] \right]
\end{array} \right\} \]

Because this strong imperative contains the very structure that licenses free choice any, we should not be surprised that any is licensed here as well. At the point where any’s licensing conditions are checked, there is no difference between a weak imperative and a strong imperative; EVEN evaluates the same alternatives in (28c) as it does in (26c). What makes strong imperatives different from weak imperatives is the application of the second exh. This exh considers the set of alternatives in (28d), where the first alterantive is simply the weak imperative discussed in (27). None of the alternatives in this set are innocently excludable; they are all innocently includable, and so they will all be asserted, in parallel to (27) and (15). The result is (29).\(^{11}\)

\[ (29) \quad \text{exh}(C_3)(\text{EVEN}_{C_2} \text{exh}_{C_1} \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book}) = 1 \iff \text{exh}_{C_1} \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \land \text{exh}_{C_1} \Diamond_{\{w_1\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \land \text{exh}_{C_1} \Diamond_{\{w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \]

When the contribution of exh to each conjunct is calculated, (29) is equivalent to (30).

\[ (30) \quad \text{exh}(C_3)(\text{EVEN}_{C_2} \text{exh}_{C_1} \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book}) = 1 \iff \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \land \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_1\}F_1F_2} \text{ book} \land \Diamond_{\{w_1,w_2\}} \text{you read } a_{\{b_2\}F_1F_2} \text{ book} \land \Diamond_{\{w_1\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \land \Diamond_{\{w_2\}} \text{you read } a_{\{b_1,b_2\}F_1F_2} \text{ book} \]

The first conjunct in (30) is identical to the meaning of the weak imperative in (27); it states that the addressee is permitted to read book 1 and permitted to read book 2. The last two conjuncts together entail that the addressee is required to read a book from the set \{b_1, b_2\} (i.e., the addressee reads a book in each world in every world in the modal’s domain). This matches with the intuitions about this imperative reported above; it conveys a command to read some book, while at the same time leaving the choice of which book to read up to the addressee.

To summarize, the proposal is that strong imperatives differ from strong modal statements in that the former, but not the latter, contain an existential modal operator (strengthened by exh).
At the point where the licensing of \textit{any} is checked, strong imperatives have the same structure as weak imperatives and weak modal statements.

4. Discussion

The analysis presented above capitalized on a key feature of the existential modal account of imperatives, namely that the structure of a strong imperative properly contains the structure of a weak imperative. Before concluding the paper, it is worth considering whether the distribution of free choice \textit{any} should be viewed as an argument in favour of this particular theory of imperatives.

Grosz (2011) proposes a version of the modal approach to imperatives where there are not one but two silent imperative modals: $\square_{\text{imp}}$ and $\diamond_{\text{imp}}$. On this view, the difference between strong and weak readings of imperatives lies in which of these operators is used. It is not obvious how such a theory would explain why $\square_{\text{imp}}$ differs from $\square_{\text{mod}}$ with respect to the licensing of free choice \textit{any}; the ambiguity version of the modal approach predicts that free choice \textit{any} would be licensed in weak imperatives and under weak modals but not in strong imperatives or under strong modals.

The main competitor to the modal approach is the minimal approach to imperatives, which holds that imperatives do not contain a modal operator at all and instead denote bare addressee-oriented properties (Hauser, 1980; Portner, 2007). On this view, the directive force of imperatives arises pragmatically; instead of updating the Common Ground, imperatives update the To-Do List, a set of properties that the conversational participants are committed to making true of themselves (Portner, 2007). The distinction between strong and weak imperatives is likewise derived pragmatically – for example, as a result of conflicting requirements on the To-Do List, or by dividing the To-Do List into different sections (Portner, 2007; von Fintel and Iatridou, 2017). Because free choice \textit{any} is not generally licensed in unembedded environments in the absence of subtrigging, this approach incorrectly predicts that \textit{any} would never be licensed in imperatives at all.

Neither a minimal approach nor an ambiguity version of the modal approach can straightforwardly capture the data discussed here. This paper can therefore be seen as an argument in favour of theories that posit a covert existential modal in the left periphery of all imperatives.

5. Conclusion

This paper has argued that the distribution of free choice \textit{any} in imperatives falls out for free on the assumptions that i) all imperatives contain an existential modal, with strong readings derived by exhaustification, and ii) the strengthening of the imperative operator happens further up the tree than the structure that licenses free choice \textit{any}.

On the view adopted here, imperatives join a growing landscape of operators whose observed strong (universal) force can be derived by strengthening an underlyingly weak (existential) meaning. Other apparently universal quantifiers that have recently been reanalyzed as strengthened existential quantifiers include the Hebrew determiner \textit{kol} (Bar-Lev and Margulis, 2014), the modal of bare conditionals (Bassi and Bar-Lev, 2016), and English \textit{want} (Staniszewski, 2019).\footnote{These operators differ from imperatives in that for them exhaustification is obligatory (cf. Chierchia 2013)} It is worth investigating how free choice \textit{any} behaves in these environments. The pro-
positional. The proposal presented here should carry over to these underlyingly existential operators, and so we should predict that free choice *any* will be licensed in the scope of *want* and in the consequent of bare conditionals. As demonstrated in (31), however, this prediction does not appear to be borne out.

(31) a. #Sam wants to read *any* book.
    b. #If the library was open, Sam read *any* book yesterday.

I do not know why *any* is not licensed in these environments, but this suggests that there are more puzzles to be worked out in this corner of the grammar. I leave the task of investigating them to future work.

References


Oikonomou, D. (2016). Imperatives are existential modals: Deriving the strong reading as an whenever it is possible. It remains to be seen whether there are other operators that are like imperatives in allowing optional strengthening.
Higher-order quantification and free choice in how many-questions

Francesco Paolo GENTILE — McGill University
Bernhard SCHWARZ — McGill University

Abstract. In Gentile and Schwarz (2018), we observed that certain how many-questions carry uniqueness presuppositions that can be understood as instances of Dayal’s (1996) Maximal Informativity Presupposition. We also observed, however, that uniqueness presuppositions can unexpectedly go missing in the presence of a possibility modal. In this paper, we offer an explanation for the obviation of such uniqueness presupposition by possibility modals. Building on a suggestion in Spector (2008), we propose that obviation is due to higher-order wh-quantification feeding free choice strengthening within the question nucleus.

Keywords: wh-questions, how many-questions, uniqueness presuppositions, Maximal Informativity Presupposition, modals, higher-order quantification, free choice strengthening.

1. Introduction

In Gentile and Schwarz (2018), we observed that how many-questions with non-distributive predicates, like solved this problem together, carry a “uniqueness-of-size” presupposition. The question in (1), for example, is intuited to presuppose that there is a unique cardinality such that a group of students of that cardinality jointly solved the problem. A response that is incompatible with this presupposition, such as 3 and 4, is accordingly judged deviant.2

(1) How many students solved this problem together?

We also observed that when a non-distributive predicate in a how many-question appears under a possibility modal, like allowed, no corresponding uniqueness presupposition is attested. To illustrate, (2) clearly does not presuppose that there is a unique allowed cardinality for groups of students jointly solving the problem. This is confirmed by the observation that 3 or 4, for example, can be felicitous as a response conveying that both 3 and 4 are permitted group sizes.

1This paper is a sequel to Gentile and Schwarz (2018), offering a solution to a puzzle that we identified there without managing to resolve. We thank Luis Alonso-Ovalle and, in particular, Aron Hirsch for comments that steered us towards our proposal. We also thank Danny Fox for discussion that helped us more clearly see some theoretical choice points and their consequences. In fact, after working out our analysis, we learned that Danny (Fox, 2019, 2020) had independently developed a solution to our puzzle, a solution that resembles ours in its appeal to free choice strengthening, but differs significantly from ours in how this notion is deployed. For reasons of space, we will in this paper lay out our analysis as initially conceived and not provide a structured review of Fox’s analysis or comparison with our own. We will, however, include sporadic footnotes with pointers and commentary on Fox’s proposal. For comments and discussion, we also thank audiences at the workshop Exhaustivity in Questions and Answers at the University of Tübingen and Sinn und Bedeutung 22 at the University of Osnabrück, as well as the members of the McGill Semantics Research Group. Of course, none of the people thanked here are responsible for any of our errors. Both authors gratefully acknowledge support from the Social Sciences and Humanities Research Council of Canada (Insight grants #435-2019-0143 and #435-2016-1448).

2In Gentile and Schwarz (2018), we note that (1) may carry a stronger presupposition, viz. that there is a unique group of students who solved the problem together. Like Fox (2019, 2020), we will focus here on the uniqueness-of-size presupposition, leaving open how it might be strengthened to a uniqueness-of-group presupposition.

In Gentile and Schwarz (2018), we noted that the uniqueness-of-size presupposition in non-modalized examples like (1) can be understood as an instance of the Maximal Informativity Presupposition (MIP) that Dayal (1996) posited in order to capture the uniqueness presupposition of singular which-questions. However, we did not provide a satisfactory explanation for the absence of uniqueness-of-size presuppositions in cases with possibility modals like (2).

In this follow-up, we will offer a way of filling this gap, building on a proposal motivated on independent grounds in Spector (2008). Following Spector, we suggest that wh-quantification in wh-questions can be higher-order, that is, can range over generalized quantifiers, and that such higher-order wh-quantification can feed so-called free choice strengthening within the question nucleus. For cases like (2), this will be shown to have the effect of closing the set of true Hamblin answers under conjunction, ensuring that the MIP in such cases amounts to a mere presupposition of existence, and thereby capturing the observed absence of a uniqueness-of-size presupposition.

Section 2 reviews the puzzle described in Gentile and Schwarz (2018). Section 3 lays out the proposed explanation for the obviation of a uniqueness-of-size presupposition in cases with possibility modals; building on Spector (2008), we attribute this obviation to higher-order wh-quantification feeding free choice strengthening. Section 4 points out that, to prevent over-obviation of uniqueness presuppositions, higher-order wh-quantification must be constrained, and we propose a constraint that has the intended effect for the examples we consider. Section 5 offers concluding remarks, regarding the analysis of free choice strengthening.

2. The uniqueness puzzle

This section reviews the puzzle described in Gentile and Schwarz (2018). We will lay out assumptions about the syntax and semantics of how many-questions that support an account of the uniqueness-of-size presuppositions as an instance of Dayal’s Maximal Informativity Presupposition (MIP). We then point out that this account fails to capture the absence of uniqueness presupposition in cases with possibility modals.

2.1. A semantics for how many-questions

We begin by laying out a proposal about the syntax and semantics of how many-questions, a proposal that adopts central assumptions from Beck and Rullmann (1999), whose analysis instantiates the so-called Hamblin-Karttunen semantics for questions (Hamblin, 1973; Karttunen, 1977). On this analysis, example (3) is taken to denote the function in (4), where \( n \) ranges over cardinalities. This function characterizes the Hamblin set in (5).

\[ \text{(3) How many students smiled?} \]

\[ \lambda p_{st}. \exists n[p = \lambda w. \exists x[\text{students}(x)(w) \land |x| = n \land \text{smile}(x)(w)]] \]
In a modern rendition of Karttunen (1977) (spelled out in, e.g., Fox, 2013), this denotation for (3) can be attributed to the logical form in (6), by assigning to the relevant functional elements the denotations given in (7) and (8). (Here we write \( n \) for the type of cardinalities.)

(6) \[ \lambda_{CP} \text{ how } \lambda_1 \text{ [ } C \ ? t_{7, st} \ ] \text{ [TP } \exists \text{ [[} t_{1, n} \text{ many] students]] smiled]] \]

(7) a. \([\text{many}] = \lambda_{n_1}. \lambda_{x_e}. |x| = n \]
    b. \([\exists] = \lambda_{f_{et}}. \lambda_{g_{et}}. \exists x[f(x) \land g(x)]\]

(8) a. \([\text{how}] = \lambda_{h_{nt}}. \exists n[h(n)] \]
    b. \([?] = \lambda_{p_{st}}. \lambda_{q_{st}}. p = q \]

So overtly pied-piped \textit{many} is taken to reconstruct into the question nucleus, composing with the cardinality-denoting trace of \textit{how} into a predicate of individuals. This predicate is taken to combine with the nominal predicate it modifies to form the restrictor of a silent existential determiner \( \exists \). The operator \( ? \) in the C position combines with the question nucleus, the TP, to form the equivalent of Karttunen’s (1977) Proto-Question. With \textit{how} in the specifier of C analyzed as an existential quantifier over cardinalities, this derives for (6) the denotation in (4).

2.2. Uniqueness from a Maximal Informativity Presupposition

Singular \textit{which}-questions carry a presupposition of uniqueness that is not attested in their plural counterparts (e.g., Higginbotham and May, 1981; Dayal, 1996). To illustrate, (9a) is judged to presuppose that only one student smiled, a presupposition that is not attested in (9b).

(9) a. Which student smiled?
    b. Which students smiled?

To capture this contrast, Dayal (1996) proposed that any question carries a so-called Maximal Informativity Presupposition about its Hamblin set: the presupposition that the Hamblin set’s true members includes one that entails all the other true members. In symbols, for a given Hamblin set \( Q \), the Maximal Informativity Presupposition is the proposition MIP(\( Q \)) in (10).

(10) \( \text{MIP}(Q) = \lambda_{w}. \exists p_\in Q[w \in p \land \forall q[w \in q \rightarrow p \subseteq q]] \)

This proposal can be shown to capture the contrast between (9a) and (9b) under the assumption that \textit{student} is true only of atomic individuals that are students, while \textit{students} also applies to pluralities of students (Link (1983)). To spell this out in the Karttunen-Hamblin semantics, the

\[ \text{Dayal (1996) takes the MIP to be triggered by a syntactically represented answer operator Ans, an operator that is intended to characterize the notion of a question’s complete answer. Since we are not directly concerned with answerhood in this paper, we will continue to suppress reference to Ans.} \]
questions in (9) have the logical forms in (11). Assuming that which is an existential determiner with the denotation in (12), the resulting sentence denotations, in a given possible world w, are as shown in (13). Illustrating for a world w with only two (atomic) students, a and b, the Hamblin set for (9a) and (9b) is then (14a) and (14b), respectively.

(11) a. \(\lambda_7[CP\ [\text{which student}] \ \lambda_1[C\ [C' [t_{7, st}] [ t_{1, e} \ \text{smiled}]])
\]
b. \(\lambda_7[CP\ [\text{which students}] \ \lambda_1[C\ [C' [t_{7, st}] [ t_{1, e} \ \text{smiled}]])
\]

(12) \([\text{which}] = \lambda_{f_{et}}. \lambda_{g_{et}}. \exists x[f(x) \land g(x)]\]

(13) a. \(\lambda_{p_{st}}. \exists x[\text{student}(w) \land p = \lambda w. \ \text{smile}(x)(w)]\)
b. \(\lambda_{p_{st}}. \exists x[\text{students}(w) \land p = \lambda w. \ \text{smile}(x)(w)]\)

(14) a. \(\{\lambda w. \ \text{smile}(a)(w), \lambda w. \ \text{smile}(b)(w)\}\)
b. \(\{\lambda w. \ \text{smile}(a)(w), \lambda w. \ \text{smile}(b)(w), \lambda w. \ \text{smile}(a \oplus b)(w)\}\)

The members of (14a) are logically independent, hence not related by entailment. In contrast, \(\text{smile}\) being distributive, \(\text{smile}(a \oplus b)(w)\) is equivalent to \(\text{smile}(a)(w) \land \text{smile}(b)(w)\), hence (14b) is closed under conjunction. For a Hamblin set whose members are not related by entailment, the MIP amounts to the requirement that only one of those members be true. For (14a), this yields the intended presupposition that only one of the students a and b smiled. In contrast, when a Hamblin set is closed under conjunction, the MIP amounts to a mere presupposition of existence. As long as the set of true Hamblin answers is non-empty, it will contain a member that entails all the others, viz. the conjunction of all the true Hamblin answers. As intended, therefore, the MIP for (14b) merely requires that at least one of the students a and b smiled.

We now apply Dayal’s proposal to how many-questions. Attending first to (3) above, note that due to the distributivity of \(\text{smile}\) and students, the Hamblin set in (5) is totally ordered by entailment, with larger cardinalities giving rise to stronger Hamblin answers than smaller cardinalities: for \(n < m\), the existence of a plurality of m smiling students guarantees the existence of a plurality of n smiling students. But a set that is totally ordered by entailment is thereby also closed under conjunction. The MIP, then, in this case amounts to a mere presupposition of existence. So example (3) is predicted to merely presuppose that there were smiling students.

We now return to example (1), repeated below as (15), which features the non-distributive predicate solve the problem together instead of distributive \(\text{smile}\), and which we said is judged to presuppose that there is only one cardinality such that a group of students of that cardinality solved the problem together.

(15) How many students solved this problem together?

Under present assumptions, (15) has the logical form (16), which determines the denotation in (17) and the Hamblin set (18). (We write spt to abbreviate solved this problem together.)

(16) \(\lambda_7[CP\ [\text{how}] \ \lambda_1[C' [t_{7, st}] [ t_{1, n} \ \text{many} [\text{students}]] spt]]\)
The members of the set in (18) are logically independent. For different cardinalities \( m \) and \( n \), the existence of a plurality of \( m \) students who solved the problem together is logically independent of the existence of a plurality of \( n \) students who solved it together. The members of (18) are therefore not related by entailment, and so the MIP requires that only one of them be true. This requirement amounts to the attested uniqueness-of-size presupposition, viz. that there is \textit{only one} cardinality such that a group of students of that cardinality jointly solved the problem.

\[ \lambda_p. \exists n [ p = \lambda_w. \exists x [ \text{students}(x)(w) \land |x|=n \land \text{spt}(x)(w)] ] \]

\[ \lambda w. \exists x [ \text{students}(x)(w) \land |x|=1 \land \text{spt}(x)(w)], \lambda w. \exists x [ \text{students}(x)(w) \land |x|=2 \land \text{spt}(x)(w)], \lambda w. \exists x [ \text{students}(x)(w) \land |x|=3 \land \text{spt}(x)(w)], \ldots \]

The central observation about this analysis is that the addition of the modal operator preserves

How many-questions, then, appear to provide striking support for the view that uniqueness presuppositions in questions arise from their Hamblin sets’ logical makeup. While how many-questions and singular which-questions differ greatly in their functional skeleton and compositional structure, the resulting Hamblin sets in both cases are equally unordered by entailment, so that in both cases the MIP correctly derives the attested presupposition of uniqueness.\(^4\)

2.3. But: obviation of uniqueness

The how many-question in (19), which repeats (2), differs from (15) in the presence of the possibility modal \textit{allowed} in the question nucleus.\(^5\) Under present assumptions, this question is assigned the logical form in (20), which will be assigned the denotation in (21), thereby determining the Hamblin set in (22).

(19) How many students are allowed to solve this problem together?

(20) \( \lambda_{CP} \text{ how } \lambda_{IC} \{ C \ ? t_{st} \} [ \text{allowed DP } \exists [t_{1,n} \text{ many} \] \text{ students]} \text{ spt} ] \]

(21) \( \lambda_p. \exists n [ p = \lambda w. \Diamond_w [ \exists x [ \text{students}(x) \land |x|=n \land \text{spt}(x)]] ] \]

(22) \( \lambda w. \Diamond_w [ \exists x [ \text{students}(x) \land |x|=1 \land \text{spt}(x)]], \lambda w. \Diamond_w [ \exists x [ \text{students}(x) \land |x|=2 \land \text{spt}(x)]], \lambda w. \Diamond_w [ \exists x [ \text{students}(x) \land |x|=3 \land \text{spt}(x)]], \ldots \]

The central observation about this analysis is that the addition of the modal operator preserves

\(^4\)However, we observe in Gentile and Schwarz (2018) that, surprisingly, uniqueness-of-size presuppositions are found in certain cases where the Hamblin sets’ logical makeup does not lead us to expect them. For example, \textit{How many students have the same name?} intuitively presupposes that there is only one cardinality \( n \) such that \( n \) students have the same name. This is surprising, since \textit{have the same name} is distributive (down to groups of two), so that the question’s Hamblin set should be ordered by entailment. Here we will set this problem aside.

\(^5\)Examples of this sort were first discussed in Beck and Rullmann (1999). Beck and Rullmann did, however, not observe the uniqueness-of-size presupposition in cases like (15), and accordingly did not discuss the obviation effect observed in modalized examples like (19).
the logical relations between Hamblin answers. Accordingly, the Hamblin set (22) is no more ordered by entailment than the one in (18). For different cardinalities m and n, the existence of a permissible world where m students solve the problem together is logically independent of the existence of a permissible world where n students do. As a consequence, the MIP will once again derive a presupposition of uniqueness, here that there is only one cardinality such that it is allowed for a group of students of that cardinality to solve the problem together.

However, as we reported above, (19) is not judged to carry a uniqueness presupposition comparable to the one attested for (15). That is, the use of the modalized question is intuited to be compatible with the assumption that there are two or more permitted group sizes. Accordingly, there is nothing deviant about responses like 3 or 4, between 5 and 15, or any even number, interpreted as conveying that both 2 and 4, all numbers between 5 and 15, or all even numbers, are permitted group sizes.

What explains this obviation effect? Why does the presence of the possibility modal obviate a uniqueness presupposition of the sort attested in its absence? Left open in Gentile and Schwarz (2018), we will now offer an answer to this question.

3. An account of uniqueness obviation

An account of the obviation effect must either reject the MIP as stated in Dayal (1996) or revise current assumptions about the membership of the participating Hamblin sets. Here we will pursue the latter avenue. Maintaining the MIP unchanged, we propose that the relevant Hamblin answers need not be those assumed above. Specifically, we propose that a modalized how many-question with a non-distributive predicate lacks a uniqueness-of-size presupposition in virtue of the set of its true Hamblin answers being closed under conjunction.

We will first explain why such closure under conjunction would have the intended effect (Section 3.1). We then propose that closure under conjunction can result under a proposal that Spector (2008) motivated on independent grounds: wh-quantification can be higher-order, in the sense of ranging over quantifiers, and such higher-order wh-quantification can feed free choice strengthening in the question nucleus (Section 3.2).

3.1. Obviation of uniqueness from closure under conjunction

The obviation effect observed in the interpretation of (19) would be captured if this question’s Hamblin set, instead of (22), could be the closure under conjunction of (22). This would have the intended effect of weakening the MIP into a mere existence presupposition. That is, the MIP would merely derive the presupposition that there is a cardinality such that it is allowed for a group of students of that cardinality to solve the problem together. Not entailing uniqueness, this presupposition is weak enough to be compatible with intuitions about (19). Closure under conjunction, then, would capture the observed obviation of uniqueness.

For a more concrete illustration of this line of attack, suppose that tacit domain restriction had reduced the set of cardinalities in how’s domain to {3, 4}. The classic Hamblin set for (19)
corresponding to (22) would then be the two-membered set in (23a); closure under conjunction would add the conjunction of the two classic members, yielding (23b).

\[
\begin{align*}
\text{(23) a. } & \left\{ \lambda w. \Diamond_w \exists x [\text{students}(x) \land |x|=3 \land \text{spt}(x)], \theta \right\}, \\
& \left\{ \lambda w. \Diamond_w \exists x [\text{students}(x) \land |x|=4 \land \text{spt}(x)] \right\} \\
\text{b. } & \left\{ \lambda w. \Diamond_w \exists x [\text{students}(x) \land |x|=3 \land \text{spt}(x)], \theta \right\}, \\
& \left\{ \lambda w. \Diamond_w \exists x [\text{students}(x) \land |x|=4 \land \text{spt}(x)] \right\}, \\
& \Diamond_w \exists x [\text{students}(x) \land |x|=3 \land \text{spt}(x)] \land \\
& \Diamond_w \exists x [\text{students}(x) \land |x|=4 \land \text{spt}(x)] \right\}
\end{align*}
\]

The pair of Hamblin sets in (23) is parallel in its logical profile to the pair in (14) above, which we presented to illustrate Dayal’s (1996) assumptions about singular and plural which-questions. The effects of the MIP are parallel as well. That is, while for (23a) the MIP delivers the unattested uniqueness-of-size presupposition that only one of the two cardinalities 3 and 4 is a permitted group size, for (23b) the MIP merely yields the weaker presupposition that at least one of those two cardinalities is permitted, capturing the observed obviation of uniqueness.

The question that remains, of course, is how the Hamblin sets for the relevant how many-questions might come to be closed under conjunction. This is the question we turn to next.

3.2. Closure under conjunction from free choice strengthening

Based on observations about how which-questions can be answered, Spector (2008) proposed that wh-questions have readings where the wh-phrase quantifies over quantifiers, and that such a construal can lead to free choice strengthening of the resulting Hamblin answers. We will review Spector’s proposal (Section 3.2.1), and we will then suggest that free choice strengthening is also a plausible source of a Hamblin set’s closure under conjunction in cases of how many-questions where obviation of uniqueness is observed (Section 3.2.2). In support of the proposed analysis, we will also present independent evidence for the assumption that how many-questions participate in higher-order wh-quantification (Section 3.2.3).

3.2.1. Free choice strengthening in which-questions

Spector (2008) reports that, as a response to the which-question in (24a), the disjunctive sentence fragment (24b) permits two different types of interpretation.

\[
\begin{align*}
\text{(24) a. } & \text{Which books is Jack allowed to read?} \\
& \text{The French or the Russian novels.}
\end{align*}
\]

It can be read as conveying that Jack is allowed to read the Russian novels or is allowed to read the French novels, thereby suggesting that the speaker is unsure which. But it can also be taken to make the stronger statement that Jack is allowed to read the Russian novels and is allowed to read the French novels. Spector refers to these readings as high and low, respectively.

Spector proposes that the high-low ambiguity is due to the question itself having a corresponding ambiguity. His assumptions about the syntax of wh-questions are somewhat different from...
those we have introduced above, so we will adjust his proposal slightly to fit the present setting. So adjusted, the analysis takes (24a) to permit logical forms of the sort sketched in (25).

\[(25)\]

\[(25a)\]

\[\lambda_7 [\text{CP} [\text{which books}] \lambda_1 [\text{C}^t [\text{? t}_{7,\text{st}}] [\text{TP} \text{allowed} [\lambda_1 [\text{Jack read t}_{1,\text{e}}]]]]]\]

\[(25b)\]

\[\lambda_7 [\text{CP} [\text{which books}] \lambda_2 [\text{C} [\text{? t}_{7,\text{st}}] [\text{TP} \text{allowed} [\lambda_1 [\text{Jack read t}_{1,\text{e}}]]]]]\]

These logical forms differ in terms of the semantic type of the highest wh-trace in the question nucleus. In (25a), this trace (index 1) denotes in type e, whereas the corresponding trace in (25b) (index 2) denotes in type (et)t. Spector takes the logical type of the highest wh-trace to fix the fragment’s scope relative to the modal operator. If this trace denotes in type e, as in (25a), the disjunction in (24b) is taken to be interpreted as scoping over allowed, yielding the high reading. If it denotes in type (et)t, as in (25b), the disjunction is taken to be interpreted as scoping below the modal. Specifically, a fragment response on its low reading is analyzed as the proposition obtained by interpreting the question nucleus relative to a variable assignment that maps the index on the type (et)t trace to the fragment’s type (et)t denotation.\(^7\) So, (24b) in its low reading is taken to be given by the question nucleus (i.e., the TP) when interpreted relative to the variable assignment \(2 \rightarrow \text{[the Russian or the French novels]}\).

As Spector notes, however, this will not actually account for the low reading without further assumptions. Assuming that allowed is an existential operator, the modal and disjunction should be scopally commutative. Such scopal commutativity should neutralize the high-low contrast, making (24b) convey unambiguously that Jack is allowed to read the Russian novels or is allowed to read the French novels. However, as Spector also points out, the stronger low reading actually attested can plausibly be analyzed as instantiating the familiar free choice effect, sketched in (26), whereby a statement with a disjunction in the scope of a possibility modal is strengthened to a conjunction of possibility statements about the individual disjuncts.

\[(26)\]

\[\diamond (p_1 \lor \ldots \lor p_n) \leadsto \diamond p_1 \land \ldots \land \diamond p_n\]

Spector does not actually propose an analysis of the free choice effect. We will likewise leave it unanalyzed here. Our point is merely that, if free choice strengthening, however analyzed, applies with the effect in (26) within the question nucleus in (25b), it will capture the intended low reading of (24b), conveying that Jack is allowed to read the Russian novels and is allowed to read the French novels.\(^8\)

Returning now to the two logical forms in (25), Spector assumes that, corresponding to the dif-

\(^7\)On this analysis, then, fragment responses are not, as Merchant (2005) has argued, clauses reduced by ellipsis. Instead, they acquire propositional content by composing directly with (a constituent given by) the question, as proposed in Jacobson (2016) and Xiang (2016). Spector actually takes the question nucleus to denote a property, and proposes that the fragment answer comes to express a proposition in virtue of composing with that property. In the case of low readings, the question nucleus in Spector’s view denotes a property of generalized quantifiers. He takes the fragment response to express the proposition obtained by applying the property denoted by the nucleus to the fragment’s denotation.

\(^8\)What this commits us to, of course, is that free choice strengthening applies in the semantics. That higher-order wh-quantification can feed free choice strengthening in the question nucleus is also proposed in Xiang (2016), which moreover spells out an analysis of the effect in terms of a syntactically represented exhaustification operator. See Section 5, as well as Fox (2020), for brief discussion of potential problems for this approach.
ference in the nucleus, they also differ in the interpretation of the wh-phrase itself. While the occurrence of which books in (25a) is taken to quantify over individuals — books and pluralities of books — the one in (25b) is taken to quantify over quantifiers — quantifiers over books and pluralities of books. The Hamblin set determined by (25b), then, will consist of propositions based on such quantifiers. To illustrate, suppose that tacit domain restriction reduces the domain of wh-quantification in (25a) to the set of pluralities \{the Russian novels, the French novels\}. The Hamblin set determined by (25a) will then be the set of classic Hamblin answers (27a). Turning to (25b), suppose there the domain of wh-quantification is the set of quantifiers \{\lambda f_{et}.f(\text{the Russian novels}), \lambda f_{et}.f(\text{the French novels}), \lambda f_{et}.f(\text{the Russian novels}) \lor f(\text{the Russian novels})\}, which in addition to two quantifiers corresponding to individuals, includes the disjunctive quantifier denoted by the fragment response (24b). Assuming free choice strengthening within the question nucleus, this domain will for (25b) yield the Hamblin set in (27b), which in addition to the two classic Hamblin answers, includes the conjunctive proposition that expresses the low reading of (24b).\(^9\)

\[
\begin{align*}
\text{(27) a.} & \quad \{\lambda w. \Box w. \text{read(\text{the Russian novels})(Jack)},
\lambda w. \Box w. \text{read(\text{the French novels})(Jack)}\} \\
\text{b.} & \quad \{\lambda w. \Box w. \text{read(\text{the Russian novels})(Jack)},
\lambda w. \Box w. \text{read(\text{the French novels})(Jack)},
\lambda w. \Box w. \text{read(\text{the Russian novels})(Jack)} \land 
\Box w. \text{read(\text{the French novels})(Jack)}\}
\end{align*}
\]

Having reviewed Spector’s analysis of low readings of which-questions with possibility modals, we will show in the next subsection that this analysis naturally extends into an account of the obviation of uniqueness in how many-questions.

Before doing so, however, we would like to clarify that our analysis of uniqueness obviation will not depend on Spector’s analysis of fragment responses being correct. What we will make use of below is merely the assumption about wh-questions that underlies this analysis of fragment responses. In fact, on an alternative analysis that comes to mind, the fragment response (24a) is a clause reduced by ellipsis (Merchant, 2005), and permits a free choice reading simply in virtue of sharing a logical form with the non-reduced clause Jack is allowed to read the Russian or the French novel in its free choice reading. By the same token, we think that free choice readings of fragment responses do not by themselves provide a compelling evidence for higher-order wh-quantification. Moreover, conjunctive Hamblin answers of the sort posited by Spector could conceivably arise from distribution over pluralities such as the Russian

\(^9\)Spector (2008) proposes that the domain of higher-order quantification by which-phrases can include any upward entailing quantifiers over the set of entities given by the wh-phrase’s overt restrictor. Under the higher-order parse of (24a), the domain of wh-quantification could then also include, for example, the conjunctive quantifier \(\lambda f_{et}. f(\text{the Russian novels}) \land f(\text{the French novels})\). Spector’s assumption is compatible with the analysis of uniqueness obviation in modalized how many-questions that we are about to propose (as it does not interfere with Hamblin sets’ closure under conjunction). Fox (2018, 2020) in fact argues that conjunctive quantifiers are obligatorily included in the domain of higher-order wh-quantification. (Fox’s argument comes from constraints on low readings described by Spector but not reviewed here.) However, the inclusion of conjunctive quantifiers undermines the central premise that our proposal is based on, viz. the proposal, reviewed in Section 2, that the uniqueness-of-size presupposition in non-modal cases can be attributed to the MIP. We return to this important issue in Section 4.
novels with scope over the possibility modal. So while Spector’s analysis of
free choice fragments sets up our analysis of uniqueness obviation, the existence of free choice
fragment responses does not by themselves furnish compelling independent motivation for it.
However, extending our report on Spector (2008), we will offer independent evidence for the
account in Section 3.2.3.

3.2.2. Application to how many-questions

We return to the problematic how many-question in (19), here repeated again as (28a). We now
note that the fragment response (28b) participates in the sort of high-low ambiguity identified
in the last subsection.

(28) a. How many students are allowed to solve this problem together?
    b. 3 or 4

The response has a high reading stating that either 3 or 4 is a permitted size of student group
solving the problem together, suggesting that the speaker is unsure which. It also has a stronger,
low, reading, conveying that both 3 and 4 are permitted group sizes. In fact, we already iden-
tified this low reading above, where we used it to confirm the absence of a uniqueness-of-size
presupposition in the meaning of (28a).

In an obvious extension of Spector’s (2008) analysis, the two readings arise from two different
logical forms for (28a). The high reading of (28b) arises when (28a) has the logical form
(20) above, the logical form that we saw is associated with an unwanted uniqueness-of-size
presupposition. According to this logical form, wh-movement of how leaves a trace that denotes
in type n, the type of a cardinalities. In contrast, the low reading is attributed to the logical form
(29), where how leaves a trace denoting in type (nt)t, the type of quantifiers over cardinalities.

(29) λ7[CP how λ2[C· C ? t7,mt ] [TP allowed [t2,(nt)t λ1[[DP ∃ [[t1,n many] students]] spt]]]]

Correspondingly, the wh-phrase how in (29) is taken to quantify not over cardinalities, but
over quantifiers over cardinalities, functions of type (nt)t. For illustration, suppose that tacit
domain restriction has reduced how’s domain to the set \{λf_{nt}.f(3), λf_{nt}.f(4), λf_{nt}.f(3) ∨ f(4)\}. Note
that this set of quantifiers is closed under disjunction. Once again assuming free choice
strengthening in the question nucleus, this domain will result in the Hamblin set (30).

(30) \[
\begin{cases}
\lambda w. \exists x [students(x) \land |x| = 3 \land spt(x)], \\
\lambda w. \exists x [students(x) \land |x| = 4 \land spt(x)], \\
\lambda w. \exists x [students(x) \land |x| = 3 \land spt(x)] \land \\
\exists x [students(x) \land |x| = 4 \land spt(x)]
\end{cases}
\]

We saw this Hamblin set before, in (23b) above. We observed that this Hamblin set is closed
under conjunction and noted that, as a consequence, the MIP amounts to a mere presupposition
of existence, capturing the attested obviation of uniqueness.

Extrapolating from this illustration, we arrive at a general analysis of uniqueness obviation
for how many-questions with non-distributive predicates. On this analysis, uniqueness can be obviated by a possibility modal in virtue of how leaving a type (nt)t trace in the modal’s scope and quantifying over quantifiers over cardinalities. If the set of quantifiers that forms how’s domain is closed under disjunction, then free choice strengthening will lead to the resulting Hamblin set being closed under conjunction. Under those circumstances, the MIP amounts to a mere presupposition of existence, capturing the obviation effect.

In summary, we have shown that the observed obviation of the uniqueness-of-size is predicted under Spector’s (2008) analysis of the high-low ambiguity of fragment answers to questions with possibility modals. If accepted, our analysis of the obviation effect therefore provides an argument for Spector’s analysis of the high-low ambiguity. In the next subsection, we identify data that add independent motivation for a central ingredient of this analysis, viz. the availability of higher-order wh-quantification.

3.2.3. Support from other types of modalized questions

Spector (2008) reports that a high-low ambiguity is also found in which-questions with universal modals in the question nucleus. He notes that, as response to (31a), the fragment in (31b) can be read in two ways.

(31) a. Which books must Jack read?
   b. The French or the Russian novels.

On its high reading, it conveys that Jack is required to read the Russian novels or is required to read the French novels, suggesting that the speaker is unsure which. On its low reading, it states that Jack is required to either read the Russian novels or read the French novels, suggesting that either will do.

In the present rendition of Spector’s analysis, these two readings of (31b) are associated with the two logical forms for (31a) shown in (32). Assuming the same domains of wh-quantification introduced for illustration above, these logical forms determine the Hamblin sets in (33).

(32) a. \(\lambda_7[CP \ [\text{which books}] \ \lambda_1[C' \ [C \ ? t_{7,sl}] \ [TP \ must \ [Jack \ read \ t_{1,e}]]]]\)
   b. \(\lambda_7[CP \ [\text{which books}] \ \lambda_2[C' \ [C \ ? t_{7,sl}] \ [TP \ must \ [t_{2,(et)t} \ \lambda_1[Jack \ read \ t_{1,e}]]]]\)

(33) a. \(\{\lambda w. \ □_w read(\text{the Russian novels})(Jack), \)
          \(\lambda w. \ □_w read(\text{the French novels})(Jack)\}\)
   b. \(\{\lambda w. \ □_w read(\text{the Russian novels})(Jack), \)
          \(\lambda w. \ □_w read(\text{the French novels})(Jack), \)
          \(\lambda w. \ □_w (read(\text{the Russian novels})(Jack) \lor \)
          \(read(\text{the French novels})(Jack))\}\)

How many-questions, including how many-question with non-distributive predicates, participate in the very same sort of ambiguity. As a response to (34a), (34b) has a high reading stating that either a group of three is required to solve the problem or a group of four is required (sug-
gesting that the speaker is unsure which). It also has a low reading, which conveys that it is required for there to be a group of three or four solving the problem (suggesting that either would do).

(34)  
  a. How many students are required to solve this problem together?  
  b. 3 or 4

The two readings can be attributed to the logical forms in (35). For the domains of wh-quantification introduced above for illustration, those logical forms determine the Hamblin sets in (36).

(35)  
  a. \( \lambda_7[CP \ how \ \lambda_1[C \ ? t_{7, st}] \ TP \ required \ [\exists [t_{1, n} \ many] \ students] \ spt]] \)  
  b. \( \lambda_7[CP \ how \ \lambda_2[C \ ? t_{7, st}] \ TP \ required \ t_{2, (int)} \ \lambda_1[ [\exists [t_{1, n} \ many] \ sts] \ spt]] \)

(36)  
  a. \( \{ \lambda w. \Box w \ \exists x[ \text{students}(x) \land |x| = 3 \land \text{spt}(x)], \lambda w. \Box w \ \exists x[ \text{students}(x) \land |x| = 4 \land \text{spt}(x)] \} \)
  
  b. \( \{ \lambda w. \Box w \ \exists x[ \text{students}(x) \land |x| = 3 \land \text{spt}(x)], \lambda w. \Box w \ \exists x[ \text{students}(x) \land |x| = 4 \land \text{spt}(x)], \lambda w. \Box w (\exists x[ \text{students}(x) \land |x| = 3 \land \text{spt}(x)] \lor \exists x[ \text{students}(x) \land |x| = 4 \land \text{spt}(x)]) \}

On Spector’s analysis of low readings with necessity modals, the proposition given by the response’s low reading is a member of the Hamblin set. As Spector argues, the inclusion of this proposition in the Hamblin set is indeed called for on empirical grounds, to capture that fact that the response’s low reading can constitute an intuitively complete answer to the question.

From our present perspective, Spector’s analysis provides an account of the apparent obviation of the existence presupposition that would otherwise be entailed by the MIP. Applied to (32a), the MIP requires that there be a particular book or plurality of books that Jack must read. Similarly, the MIP for (45a) demands that there be a particular cardinality such that a group of students of that cardinality must solve the problem together. The intuition that (31b) and (34b) can be complete answers (despite not portraying any particular books or cardinalities as being required) indicates that those existence presuppositions can be absent. The logical forms (32b) and (35b), and the Hamblin sets they determine, can account for this observation. This is apparent from the fact the disjunctive, non-classic, Hamblin answers in (33b) and (36b) can be the only true propositions in those sets. In that case, those disjunctive Hamblin answers will be the strongest true members of their Hamblin sets, and so the MIP will be satisfied despite all the classic Hamblin answers being false.

Questions with necessity modals, then, provide independent evidence for the assumption that wh-questions, and how many-questions in particular, permit wh-quantification over quantifiers – evidence that does not rely on assumptions about the analysis of fragment answers. Further support of this sort comes from how many-questions with a possibility modal in the scope of negation, such as (37). Consider the logical forms in (38) and the Hamblin sets in (39).
(37) How many students are not allowed to solve this problem together?

(38) a. $\lambda \gamma_1 [C' \exists [t_1, n] \exists [t_1, n] not [allowed [DP \exists [t_1, n] many students] spt]]])$

b. $\lambda \gamma_2 [C' \exists [t_1, n] t_2, int \lambda_1 [DP \exists [t_1, n] many students] spt]]])$

(39) a. $\begin{cases} \lambda w. \neg \diamond w \exists x [students(x) \wedge |x| = 3 \wedge spt(x)], \\
\lambda w. \neg \diamond w \exists x [students(x) \wedge |x| = 4 \wedge spt(x)] \end{cases}$

b. $\begin{cases} \lambda w. \neg \diamond w \exists x [students(x) \wedge |x| = 3 \wedge spt(x)], \\
\lambda w. \neg \diamond w \exists x [students(x) \wedge |x| = 4 \wedge spt(x)], \\
\lambda w. \neg \diamond w (\exists x [students(x) \wedge |x| = 3 \wedge spt(x)] \vee \\
\exists x [students(x) \wedge |x| = 4 \wedge spt(x)]) \end{cases}$

Note that the classic Hamblin answers in (39a) are logically independent, so the MIP requires that only one of them be true. So if only the logical form (38a) were available, (37) should presuppose that there is a unique cardinality such that it is not allowed for a group of that cardinality to solve the problem. Intuitions indicate, however, that (37) carries no such presupposition. This is shown by the observation that (37) can be answered felicitously with, say, 3 or 4 to convey that neither 3 nor 4 is a permitted group size. This judgment is captured by the logical form (38b) and its Hamblin set (39b), given that this set includes the proposition that neither 3 nor 4 is allowed. More generally, higher-order quantification over quantifiers allows for the Hamblin set for (37) to be closed under conjunction. (37) is therefore predicted to merely carry a weaker presupposition of existence, viz. that there is some cardinality such that groups of that cardinality are not allowed to solve the problem.

So how many-questions with a possibility modal under negation provide further independent evidence for the assumption that how many-questions permit higher-order wh-quantification. Notably, this evidence is, once again, independent of the analysis of fragment answers.

Summarizing again, Spector’s analysis of the high-low ambiguity of fragment responses to which-questions permits a parsimonious extension that captures the obviation of the uniqueness-of-size presupposition in how many-questions. This is a satisfying result. But it also leads to an important remaining question. What remains to be investigated is whether the proposed analysis of obviation preserves the account of uniqueness-of-size presupposition in those cases where it is attested. This is the question that we will now turn to.

4. Reining in higher-order wh-quantification

To explore the consequences of our proposal for the analysis of non-modalized questions, let us return to example (15), repeated here once again in (40). In Section 2, we proposed to attribute the uniqueness-of-size presupposition carried by this example to the MIP.

(40) How many students solved this problem together?

10 Fox (2010) reports the corresponding judgment about which-questions, noting that as a response to Which books are we not allowed to read?, the fragment response The French books or the Russian books can convey that we are not allowed to read either set of books.
This proposal was based on the assumption that (40) is assigned the logical form (41a), which gives rise to a classic Hamblin set of propositions about particular cardinalities. However, parallel to the analysis of the modalized questions, we must now also consider the logical form (41b), where wh-movement has left a trace denoting in type (nt)t, and where how’s domain is accordingly taken to consist of quantifiers over cardinalities.

\[
\begin{align*}
(41a) & \quad \lambda_7[\text{CP how} \lambda_1[\text{C’} [C ? t_{7,st}] [\text{TP} [\text{DP} \exists [[t_{1,n} \text{ many} \text{ students}] \text{spt}]]]] \\
(41b) & \quad \lambda_7[\text{CP how} \lambda_2[\text{C’} [C ? t_{7,st}] [\text{TP} t_{2,(nt)t} \lambda_1[\text{DP} \exists [[t_{1,n} \text{ many} \text{ students}] \text{spt}]]]]
\end{align*}
\]

In our discussion of wh-quantification over cardinalities, we have so far considered domains that include quantifiers that correspond to basic entities, such as $\lambda f_{nt}. f(3)$, as well as the disjunction of such quantifiers, such as $\lambda f_{nt}. f(3) \lor f(4)$. However, Spector (2008) actually proposed that the domain of higher-order wh-quantification can comprise any upward monotone quantifiers, including conjunctive quantifiers like $\lambda f_{nt}. f(3) \land f(4)$.

In the context of our analysis, the inclusion of conjunctive quantifiers in the domain of higher-order wh-quantification is problematic. It conflicts with the starting point of our paper, the assumption that the uniqueness-of-size presupposition is an instance of the MIP. To illustrate, suppose the domain of how is the set of quantifiers \{\(\lambda f_{nt}. f(3)\), \(\lambda f_{nt}. f(4)\), \(\lambda f_{nt}. f(3) \land f(4)\)\}. The logical form (41b) will yield the Hamblin set in (42).

\[
\begin{align*}
(42) & \quad \left\{
\begin{array}{l}
\lambda w. \exists x[\text{students}(x)(w) \land |x| = 3 \land \text{spt}(x)(w)], \\
\lambda w. \exists x[\text{students}(x)(w) \land |x| = 4 \land \text{spt}(x)(w)], \\
\lambda w. \exists x[\text{students}(x)(w) \land |x| = 3 \land \text{spt}(x)(w)] \land \\
\exists x[\text{students}(x)(w) \land |x| = 4 \land \text{spt}(x)(w)]
\end{array}\right. 
\end{align*}
\]

This Hamblin set is closed under conjunction, and as a consequence, the MIP will amount to a mere presupposition of existence. It will be true as long as at least one of the cardinalities 3 and 4 is the size of a student group who solved the problem together. More generally, permitting conjunctive quantifiers in how’s domain amounts to permitting higher order domains that are closed under conjunction. In the absence of an additional operator, this would yield Hamblin sets that are closed under conjunction, predicting unwanted obviation of uniqueness even in non-modal cases, where the uniqueness-of-size presupposition is invariably attested.

We are led to conclude that, if logical forms like (41b) are available, then the domain of higher-order wh-quantification must be taken to exclude conjunctive quantifiers. The data presented in Spector (2008) indeed appear compatible with this hypothesis. To illustrate with an example of our own, note that (43a) permits (43b) as a felicitous response in a low reading, according to which Jack’s reading requirements are met if he reads either Buddenbrooks and The tin drum or Buddenbrooks and The magic mountain.

\[
(43) \quad \begin{align*}
a. & \quad \text{Which books must Jack read?} \\
b. & \quad \text{Buddenbrooks and either The tin drum or The magic mountain.}
\end{align*}
\]

The Hamblin answer corresponding to this low reading could enter the question’s Hamblin set in virtue of the wh-quantification’s domain including the conjunctive quantifier $\lambda f_{nt}. f(\text{The...})$.\]
Buddenbrooks) ∧ (f(The tin drum) ∨ f(The magic mountain)). However, given that read is distributive in its object position, the relevant Hamblin answer can just as well be credited to the disjunctive quantifier λf ∈ {Buddenbrooks, The tin drum} ∨ Buddenbrooks ⊕ The magic mountain).

Given the availability of distribution over pluralities, then, which-questions with necessity modals do not seem to furnish evidence against (or for) our hypothesis that the domain of higher-order wh-quantification excludes conjunctive quantifiers. This invites us to consider wh-questions where distribution over pluralities in the wh-phrase’s domain is not available.

How many-questions are a case in point. The very fact that (40) carries a uniqueness-of-size presupposition indicates that distribution over pluralities of cardinalities is not available there. Such distribution too would result in Hamblin sets like (42), again losing the proposed account of the uniqueness-of-size presupposition.

Given this, consider again (34a), repeated below as (44), together with the logical forms in (45). With conjunctive quantifiers excluded from how’s domain, and in the absence of distribution over plural cardinalities, we are led to maintain that (44) has Hamblin sets like those in (46), repeated from (35) and (36).

(44) How many students are required to solve this problem together?

(45) a. λ7{CP how λ1[C: C ? t7,s,t ] [TP required [DP ∃ [[t1,n many] students] spt]]]
b. λ7{CP how λ2[C: C ? t7,s,t ] [TP required t2,(nt)t λ1[[DP ∃ [[t1,n many] s]] spt]]]}

(46) a. \{λw. □w ∃x [students(x) ∧ |x| = 3 ∧ spt(x)], λw. □w ∃x [students(x) ∧ |x| = 4 ∧ spt(x)]\}
b. \{λw. □w ∃x [students(x) ∧ |x| = 3 ∧ spt(x)], λw. □w ∃x [students(x) ∧ |x| = 4 ∧ spt(x)], λw. □w (∃x [students(x) ∧ |x| = 3 ∧ spt(x)] ∨ ∃x [students(x) ∧ |x| = 4 ∧ spt(x)])\}

Note now that the classic Hamblin answers that are shared by the two Hamblin sets in (46) are logically independent. Since neither set includes the conjunction of those classic Hamblin answers, the MIP entails that only one of them is true, i.e. that only one of the cardinalities 3 and 4 is such that there must be a group of that size solving the problem. More generally, excluding conjunctions from the domain of higher-order wh-quantification predicts that, like its non-modal counterpart (40), (44) carries a uniqueness-of-size presupposition; here the presupposition that there is only one cardinality such that a group of that size must solve the problem.

11 Xiang (2016) argues for higher-order wh-quantification over conjunctive quantifiers in which-questions with non-distributive predicates, like Which students solved the problem together?. This proposal allows for the Hamblin sets for such questions to be closed under conjunction, despite being built on non-distributive predicates. This, in turn, provides an account for the absence of an uniqueness presupposition in such cases, which Xiang (2016) was the first to draw attention to. However, Fox (2019, 2020) argues for an alternate to route to closure under conjunction in such cases, viz. distribution over higher-order pluralities (Landman, 1989a, b). Assuming that Fox’s proposal is viable, which-questions with non-distributive predicates do not after all shed light on the makeup of the domain of higher-order wh-quantification.

12 Comments by Danny Fox (personal communication; also Fox, 2020) have helped us see this issue more clearly.
There are observations that conform with this prediction. As responses to (44), conjunctive fragments like \(3 \text{ and } 4\) strike us as a deviant, as do fragments like \(3 \text{ and either } 4 \text{ or } 7\). What might account for the contrast between such responses and fully felicitous, purely disjunctive, responses like \(3 \text{ or } 4\)? Our hypothesis that conjunctive quantifiers are excluded from the domain of \(w\)-quantification, in conjunction with the assumption that distribution over pluralities of cardinalities in the question nucleus is unavailable, provides a straightforward answer.

Our negation example (37), repeated below as (47), can be used to make a related point. The relevant observation is that it seems quite impossible to interpret a conjunctive response to (47) like \(3 \text{ and } 4\) in a low reading.

(47)  How many students are not allowed to solve this problem together?

That is, this response cannot be understood as denying the existence of permissible worlds where the set of cardinalities of student groups who solve the problem includes both 3 and 4. If the question (47) permitted a Hamblin answer that expresses such a denial, the unavailability of the low reading for \(3 \text{ and } 4\) would be surprising. In particular, it is hard to see what would account for the contrast between \(3 \text{ and } 4\) and its disjunctive counterpart \(3 \text{ or } 4\), which we observed in Section 3 naturally lends itself to a low interpretation.\(^{13}\)

We conclude that observations about \(\text{how many}\)-questions with necessity modals and possibility modals under negation furnish independent support for the assumption that the domain of \(\text{how}\) cannot include conjunctive quantifiers.\(^{14}\)

5. Concluding remarks

Building directly on Spector (2008), we have proposed that obviation of the uniqueness-of-size presupposition in (28a), repeated once more in (48), is due to higher-order \(w\)-quantification that feeds free choice strengthening of Hamblin answers. However, like Spector, we have remained silent on the workings of free choice strengthening, assuming merely that it applies in the question nucleus and takes the form sketched in (49), repeated from (26). Relying in this characterization of free choice strengthening, we illustrated its intended effect on (48) by crediting the Hamblin set (30), repeated here as (50), to the set \(\{\lambda f_{\text{int}}.f(3), \lambda f_{\text{int}}.f(4), \lambda f_{\text{int}}.f(3) \lor f(4)\}\) as the domain of \(w\)-quantification.

(48)  How many students are allowed to solve this problem together?

(49)  \(\Diamond (p_1 \lor \ldots \lor p_n) \sim \Diamond p_1 \land \ldots \land \Diamond p_n\)

\(^{13}\)Under the assumption that the domain of \(\text{how}\) excludes conjunctive quantifiers, the unavailability of a low reading for \(3 \text{ and } 4\) could be attributed to the observation that it would not actually address the question. As the reader is invited to confirm, under the assumption that conjunctive quantifiers are excluded form the domain of the \(w\)-quantification, the low reading fails to discriminate between cells of the partition that the question determines.

\(^{14}\)However, Fox (2020) reports judgments that are in conflict with those we reported above. For example, Fox reports that \(\text{How many students should solve this problem together}\?) can be answered felicitously with \(\text{Between 5 and 7 (the small group) and between 8 and 10 (the large group)}\). We suspect that this response reflects that (47) marginally allows for a pair-list reading that pairs cardinalities with groups, but we are at present unable to substantiate this suspicion.
In an approach pioneered by Fox (2007), free choice strengthening can arise from exhaustification, the strengthening process that also gives rise to scalar implicatures, and exhaustification is credited to syntactically represented operator exhaustification, Exh. A central benefit of this approach in the present context is that it permits strengthening of individual Hamblin answers, by positing that Exh can appear in the question nucleus. However, exhaustification may not actually deliver (50). Exhaustification is relative to a set of alternative propositions. If this alternative set is equated with the Hamblin set that would obtain in the absence of exhaustification, then free choice strengthening should result in (51) instead of (50).

So the Hamblin answers resulting from free choice strengthening would be mutually incompatible propositions. This can be shown to be inconsequential for the content of the presupposition delivered by the MIP. For a set of exhaustified, mutually incompatible, Hamblin answers, the MIP is met just in case one of the exhaustified answers is true, which is equivalent to saying that the set of true classic, non-exhaustified, Hamblin answers contains one that entails all the others. In particular, the MIP maps (51) to the same proposition as (50), viz. the proposition that at least one of the cardinalities 3 and 4 is such that a student group of that cardinality is allowed to solve the problem together.

However, if free choice strengthening of Hamblin answers always rendered Hamblin answers mutually incompatible, then the obviation of uniqueness in questions embedded under responsive predicates (in the sense of Lahiri, 2002) should force strongly exhaustive readings in the sense of Groenendijk and Stokhof (1984). Exploring this prediction, and its consequences for the analysis of uniqueness obviation, is a task that we leave for future work.

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A compositional semantics for free choice constituent unconditionals

Aurore GONZALEZ — Harvard University
Karoliina LOHINIVA — New York University

Abstract. The realization of unconditionals is subject to variation across different languages (Haspelmath and König, 1998). In this paper, we zoom in on European French, and propose a unified analysis of two types of constituent unconditionals (CUs) in the language. On the syntactic side, we propose that in both types of CUs, the adjunct clause always contains a free choice item (FCI), but this FCI can be partially elided. On the semantic side, we propose a fully compositional analysis of these two types of CUs. We further derive the characteristic properties of CUs (Haspelmath and König, 1998; Rawlins, 2013) from exhaustification (Chierchia, 2013: among others) and the principle of viability (Dayal, 2013), which have been argued to play a crucial role in the semantics of FCIs. Our approach is thus closely related to recent work on alternative unconditionals in Hungarian (Szabolcsi, 2019) and free choice in Romance (Caponigro and Fălăuș, 2018), and contrasts with previous work on English, where the CU adjunct clause is analyzed as a wh-question (Rawlins, 2013).

Keywords: Unconditionals, Free Choice, French, exhaustification, viability.

1. Introduction

There is considerable cross-linguistic variation in the realization of constituent unconditionals (CUs) (Haspelmath and König, 1998; Quer and Vicente, 2009; Balusu, 2019; Šimík, 2019; Szabolcsi, 2019). In this contribution, we focus on European French (henceforth, ‘French’), where the adjunct clause can be headed by a bare-looking wh (1a) or a wh que ce soit free choice item (FCI) (1b). For ease of presentation, we will call the relevant CUs ‘short’ and ‘long’. As far as we know, there is no discernible difference in meaning between long and short CUs.

(i) [adjunct Quelle que soit sa décision ], [main Lou sera contente. ]
   which REL is.SBJ her decision Lou is.FUT happy
   ‘Whichever decision they make, Lou will be happy.’

(ii) [adjunct Quoi que Zoé cuisine ], [main c’est excellent. ]
   what REL Zoé cooks.SBJ it-is excellent
   ‘Whatever Zoé cooks, it is excellent.’

The first goal of our contribution is to provide a unified syntactic analysis of short and long CUs. In previous work, the existence of short and long CUs has been noticed, but no tenable unified analysis has been proposed. For example, Corblin (2010) proposes that long CU adjuncts are formed by moving a *wh*-word in two steps, as in (2). While Corblin does not discuss the analysis of short CUs, one may assume that their adjuncts simply lack the second, higher movement step under Corblin’s account.

(2) \[ [_{CP} quoi \ [\text{que}] \ [_{TP} ce\ soit\ [\text{que}]\ Zoé\ cuisine\ ] \]]

There is a major issue with this approach, however: in (2), there is no constituent corresponding to the FCI *quoi que ce soit*, but as we show in this paper, there is independent evidence showing that long CU adjuncts do contain such FCIs. This in turn raises the question of whether a unified analysis of short and long CUs – especially with respect to the elements they contain – is possible. In this paper, we argue that it is.

The second goal of our contribution is to provide a fully compositional semantic analysis of short and long CUs in French. We show in detail that French CUs cannot be accounted for using the question-based analysis of CUs proposed by Rawlins (2013). For Rawlins, English CU adjuncts are underlyingly *wh*-questions, which means that they denote sets of propositions (3a). Under this analysis, CUs are built composing each adjunct-contained alternative point-wise with the modalized main clause. This produces a set of conditionals (one conditional per adjunct-contained alternative), which then undergoes universal closure at the top (3b). Rawlins therefore formalizes the long-standing intuition that unconditionals denote conjunctions of conditionals (Haspelmath and König, 1998).

(3) \[ [\text{Whatever Zoé cooks}]_{\text{CU-adjunct}}, \text{Lou will be happy} \]

a. \[ [\text{Whatever Zoé cooks}] = \{\text{Zoé cooks } a, \text{Zoé cooks } b, \ldots \} \]

b. \[ [\text{Whatever Zoé cooks}, \text{Lou will be happy}] = \{\text{If Zoé cooks } a, \text{Lou will be happy} \land \text{If Zoé cooks } b, \text{Lou will be happy} \land \ldots \} \]

\^Noe that Corblin (2010) actually takes the relative clause *que Zoé cuisine* to attach at the level of S (i.e., TP). However, given that the relative clause contains the trace of the moved *wh*-phrase, we let it directly modify the *wh*-phrase in (2).
Whether they are French or English, CUs are characterized by (at least) two core interpretational properties: consequent entailment and speaker ignorance. On Rawlins’ account, consequent entailment is closely tied to the use of \textit{wh}-semantics, and especially the Q(uestion)-operator. To illustrate, consider (3). It is clear that the use of (3) presupposes that Zoé cooks something, i.e., (3) has an existential presupposition.\footnote{Rawlins refers to this presupposition as \textit{exhaustivity}, as it dictates that the adjunct clause alternatives exhaustively cover the space of possibilities, which means that they cannot all be false.} For Rawlins, this presupposition comes from the semantics of the Q-operator.\footnote{On Rawlins’ account, the Q-operator also gives rise to an \textit{exclusivity} presupposition whereby the adjunct clause alternatives cannot overlap, meaning that they cannot be true at the same time. Our data indicates that exclusivity does not play a role in French CUs, but due to lack of space, we must leave the discussion of the issue for future work.} Now, given that some alternative in (3a) is presupposed to be true, the CU as a whole entails the consequent, i.e., that Zoé will be happy.\footnote{Any of the adjunct-alternatives is just as good an option as the other ones, and the truth of the consequent does not depend on which adjunct clause alternative is true in the end (‘relative indifference’ in Rawlins, 2013).} Consequent entailment is a core semantic property of CUs, and as such, any semantic account of CUs – whether or not it uses question semantics – must deliver it.

The second core semantic property, namely, speaker ignorance, is not directly linked to question semantics under Rawlins’ analysis. This property is illustrated in (4), where the infelicitous \textit{namely}-phrase specifies the identity of the entity that is being cooked (see Dayal, 1997).\footnote{Speaker ignorance is obligatory in episodic CUs, which is what we will focus on in this contribution. See Rawlins (2013) and Szabolcsi (2019) for a discussion on how non-episodicity affects speaker ignorance in unconditionals.} Rawlins proposes that in English, speaker ignorance is due to the presence of \textit{-ever}, which also appears in many \textit{wh-ever} free relatives, and \textit{wh-ever} questions.

\begin{equation}
\text{(4) Whatever Zoé cooks – \#namely, tomato soup – Lou will be happy.}
\end{equation}

Thus, as we argue that short and long CUs in French cannot be accounted for using a question-based analysis, we must provide an alternative explanation of the aforementioned core interpretational properties of CUs. We do this by assuming that both types of CUs we consider involve the relativization of a FCI, and this FCI is partly elided in short CUs. Under our analysis, speaker ignorance and consequent entailment follow from the semantics of free choice, or more specifically, exhaustification (Chierchia, 2013: among others) and the principle of viability (Dayal, 2013). Given our reliance on free choice semantics, our approach is closely related to recent work on unconditionals in Hungarian (Szabolcsi, 2019) and free choice phenomena in Romance (Caponigro and Fălăuş, 2018).

This paper is organized as follows. We begin in section 2 by presenting a number of arguments against adopting a question-based analysis of French CUs, and in favour of an analysis involving FCIs. We then propose a syntactic and semantic analysis of long and short CU adjuncts in section 3. In section 4, we show how the viability condition on the licensing of FCIs is responsible for speaker ignorance in French CUs. Section 5 shows how the adjunct clause composes with the main clause, and how viability is also responsible for consequent entailment under our analysis. Section 6 concludes.
2. Arguments for the involvement of FCIs in French CUs

In this section, we present a number of arguments for the involvement of free choice and FCIs in French CUs. On the one hand, these arguments serve as the foundation on which we build our analysis of French CUs. On the other hand, they also serve as arguments against a potential alternative analysis of French CUs as involving wh-questions (Rawlins, 2013).

2.1. Matching paradigm gaps

The first argument for the involvement of FCIs and not wh-phrases in French CU adjuncts comes from an interesting match in paradigm gaps. Specifically, only those wh-phrases that appear in wh que ce soit FCIs appear in short and long CUs. For example, (5) shows that où can appear in both a FCI and CU, and (6) shows that quand can appear in neither. Table 1 illustrates the matching paradigm gaps for all French wh-phrases.

(5) a. Zoé peut cuisiner [ou que ce soit].
   Zoé can cook.INF where REL it.is.SBJ
   ‘Zoé can cook anywhere.’
   [FCI]

   b. Où (que ce soit) que Zoé cuisine, ...
   where REL it.is.SBJ REL Zoé cooks.SBJ
   ‘Wherever Zoé cooks, ...’
   [CU]

(6) a. * Zoé peut cuisiner [quand que ce soit].
   Zoé can cook.INF when REL it.is.SBJ
   Int. ‘Zoé can cook anytime/whenever.’
   [FCI]

   b. * Quand (que ce soit) que Zoé cuisine, ...
   when REL it.is.SBJ REL Zoé cooks.SBJ
   Int. ‘Whenever Zoé cooks, ...’
   [CU]

<table>
<thead>
<tr>
<th>Wh-word</th>
<th>FCI</th>
<th>Short or long CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>quoi 'what'</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>qui ‘who’</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>où ‘where’</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>quand ‘when’</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>comment ‘how’</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>pourquoi ‘why’</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>combien ‘how much’</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Table 1: Matching paradigm gaps in *wh que ce soit* FCIs and short/long CUs in French
Under our proposal, the ungrammaticality of the FCIs – whatever its reason – explains the ungrammaticality of the corresponding CUs, which lends support to a FCI-based analysis of CUs. In contrast, a question-based analysis would need additional assumptions to account for the data, given that *quand, comment, pourquoi* and *combien* form *wh*-questions in French (data not shown). These *wh*-phrases would thus be expected to be able to form at least short CU adjuncts, contrary to fact.

2.2. Modification by *d’autre* and *diable*

The second argument for the non-involvement of questions and in favor of the involvement of FCIs comes from the modifiers *d’autre* ‘else’ and *diable* lit. ‘devil’, of which the latter plays the role of *the hell* in French. To begin, note that French allows *d’autre* and *diable* to directly attach to a fronted *wh*-phrase in *wh*-questions.

\[(7) \text{a. } \text{Qui } \{ \text{d’autre / diable} \} \text{ as-tu vu?} \quad \text{[WH]} \]

‘Who else have you seen?’ or ‘Who the hell have you seen?’

\[\text{b. } \text{De quoi } \{ \text{d’autre / diable} \} \text{ as-tu besoin?} \quad \text{[WH]} \]

‘What else do you need?’ or ‘What the hell do you need?’

Let us first consider *d’autre*. In contrast to *wh*-phrases in *wh*-questions, *d’autre* cannot modify the *wh*-part of a FCI directly (8a), and must instead appear at the very end of the FCI (8b).

\[(8) \text{a. } \text{Tu peux manger [ quoi d’autre que ce soit ]}, \text{ mais pas ça.} \quad \text{[FCI]} \]

‘You can eat anything else, but not that.’

\[\text{b. } \text{Tu peux manger [ quoi que ce soit d’autre ]}, \text{ mais pas ça.} \quad \text{[FCI]} \]

‘You can eat anything else, but not that.’

Crucially, both short and long CU adjuncts pattern like FCIs, and not like *wh*-questions, with respect to *d’autre* (9). The question-based analysis leaves the unacceptability of short CUs with *d’autre* unexplained (9a).

\[(9) \text{a. } \text{*Quoi d’autre (que ce soit) que tu cuisines, …} \quad \text{[CU]} \]

‘Whatever else you cook, …’
Now, moving to *diable*, it should be noted first that *diable* is restricted to appearing in *wh*-questions in French. Thus, under a question-based analysis of CUs, *diable* should be just as acceptable in CUs as it is in (7). This is not the case – not even in short CUs – as (10) shows.

(10) a. *Qui *diable (que ce soit) que Zoé ait vu, ...
who devil REL it is.SBJ REL Zoé have.SBJ seen
   Int. ‘Whatever the hell Zoe has seen, …’

   b. *Qui que ce soit *diable que Zoé ait vu, ...
what REL it is.SBJ devil REL Zoé have.SBJ seen
   Int. ‘Whatever the hell Zoe has seen, …’

Thus, data from modification by *d’autre* and *diable* support a FCI-based analysis of French CUs, and not a question-based analysis.

2.3. Speaker ignorance and indifference

The third argument for the involvement of FCIs in French CUs comes from the fact that FCIs and CUs give rise to the same modal inferences. First, like FCIs in argument position (11a), short and long CUs require speaker ignorance (11b), as shown by the *namely*-test (Dayal 1997):

(11) a. #J’utiliserai quoi que ce soit qu’on ait [FCI]
   I-use.FUT what REL it is.SBJ REL-we have.SBJ
   dans la cave – à savoir une pince coupante.
in the basement namely a wire cutter
   ‘To fix the sink, I will use what we have in the basement (#namely, a wire cutter).’

   b. #Quoi (que ce soit) qu’on ait dans la cave, [CU]
what REL it is.SBJ REL-we have.SBJ in the basement
   – à savoir une pince coupante – je pourrai réparer l’évier.
namely a wire cutter I can.FUT fix the-sink
   ‘Whatever we have in the basement (#namely, a wire cutter), I will be able to fix the sink.’

In addition to speaker ignorance, FCIs and CUs are similar in that they may both be accompanied by an indifference inference. This inference pertains to the agent’s indifference with respect to the identity of the entity (von Fintel, 2000; Condoravdi, 2015). Normally, this type of inference can be probed by adding a phrase like *as it happens*. However, given that both FCIs and CUs come with obligatory speaker ignorance in examples such as (11), and *as it happens* and equivalent test phrases are incompatible with speaker ignorance, it is not possible to bring out the indifference inference with this test in French, as shown by the infelicity of (12).
(12) a. #J’ai sélectionné qui que ce soit que Zoé ait nominé – en loccurrence, Emma.
   I-have chosen who REL it is.SBJ REL Zoé has.SBJ nominated in this case Emma
   ‘I selected whoever Zoe nominated – #Emma, as it happens.’

b. #Qui (que ce soit) que j’aie sélectionné, en l’occurrence, Emma – Lou était ravie.
   who REL it is.SBJ I-have.SBJ chosen in this case Emma Lou is.PAST happy
   ‘Whoever I selected – #Emma, as it happens – Lou was happy.’

In sum, the modal inference data form another argument for grouping FCIs and CUs together.

2.4. Other FCIs in CUs

As the final piece of evidence for the presence of FCIs in French CU adjuncts, we show that two other types of FCIs may also occur in CU adjuncts: an example with a n’importe wh FCI is given in (13), and an example with a quelque N que ce soit FCI is given in (14). A pure question-based analysis does not predict the appearance of FCIs in CUs.

(13) a. Zoé peut cuisiner [ n’importe quoi ].
   Zoé can cook.INF NE-matters what
   ‘Zoé can cook anything.’

b. N’importe quoi que Zoé cuisine, ...
   NE-matters what REL Zoé cooks.SBJ
   ‘Whatever Zoé cooks, …’

(14) a. Zoé peut cuisiner [ quelque plat que ce soit ].
   Zoé can cook.SBJ some dish REL it is.SBJ
   ‘Zoé can cook any dish.’

b. Quelque plat (que ce soit) que Zoé cuisine, ...
   some dish REL it is.SBJ REL Zoé cooks.SBJ
   ‘Whichever dish Zoé cooks, …’

In conclusion, in section 2, we have provided different types of evidence for our claim that French CUs involve FCIs, and are not formed from wh-questions (Rawlins, 2013). In addition, we have shown that short and long CUs behave alike in many respects, which calls for a unified analysis of the two types of CUs.

9Muller (2006) notes the appearance of n’importe wh FCIs in CUs, but not quelque N que ce soit FCIs.
3. Syntax and semantics of CU adjunct clauses

In this section, we begin by providing a unified syntactic analysis of short and long CUs. We then give a fully compositional semantics for CU adjunct clauses.

3.1. Structure of CU adjunct clauses

We propose that the syntax of French CU adjunct clauses involves a double relativization process. First, we form a FCI by relativizing a wh-word from inside a copular clause. In (15), this wh-word is quoi, and the result is a quoi que ce soit FCI.10

(15)

```
QP
  Q
      quoi_i REL→que TP
           ce soit t_i
```

Then, this FCI is itself relativized, and ends up heading the CU adjunct clause. On this analysis, the CU adjunct in (16a) has the structure in (16b).

(16) a. Quoi que ce soit que Zoé cuisine, ...
    what REL it is.SBJ REL Zoé cooks.SBJ
    ‘Whatever Zoé cooks, …’

b. CP
   QP
      Q
          quoi_j REL→que TP
             ce soit t_j
       REL→que TP
             Zoé cuisine t_i

Having argued in Section 2 that both short and long CUs involve FCIs, we now propose a unified syntactic analysis of these two constructions. Specifically, we claim that the structure of both short and long CU adjunct clauses involve the relativization of a wh que ce soit FCI, as in (16). The difference between short and long CUs is due to ellipsis: short CU adjuncts are

10At this point, we do not provide any independent arguments for our analysis of wh que ce soit FCIs, as that is not the main goal of our contribution. Crucially, our analysis of CU adjunct clauses remains the same regardless of whether the inner syntax of the FCI involves relativization. We leave it for further work to determine whether the presented analysis of wh que ce soit FCIs is correct.
short, because the whole *que ce soit* relative clause (RC) has been elided. As an illustration, (17b) shows the structure of the short CU adjunct in (17a). \( \Delta \) marks the RC that is elided.\(^{11}\)

(17) a. *Quoi que Zoé cuisine, ...*

   what REL Zoé cooks.SBJ

   ‘Whatever Zoé cooks, ...’

b. 

\[ \text{CP} \]

\[ \text{QP}_i \]

\[ Q \]

\[ \Delta \]

\[ \text{REL} \Rightarrow \text{que} \]

\[ \text{TP} \]

\[ \text{Zoé cuisine } t_i \]

\[ \text{REL} \Rightarrow \text{que} \]

\[ \text{TP} \]

\[ \text{ce soit } t_j \]

3.2. Composition of CU adjunct clauses

We propose a transparent mapping between the syntax and semantics of CU adjunct clauses. In a nutshell, we claim that the *wh* is an existential generalized quantifier that combines with two RCs, as shown in (18). \( \text{RC}_1 (\text{que ce soit}) \) provides the quantificational domain of the *wh*. The *wh que ce soit* FCI then combines with the subjunctive RC\( _2 \), which contains a covert epistemic modal (Quer, 1998; Chierchia, 2013; Dayal, 2013).

(18)

\[ \text{CP} \]

\[ \text{QP}_i \]

\[ Q \]

\[ \text{RC}_1 \]

\[ \text{λ}.x.\exists w'.ACC_w'(w') [\text{cooks}_w'(x)(z)] \]

\[ \text{λ}.x.\exists x [P(x) \land Q(x)] \]

\[ \text{λ}.x.D_w(x) \]

\[ \text{λ}.x.\exists w'.ACC_w'(w') [\text{cooks}_w'(x)(z)] \]

\[ \text{cooks}_w'(x)(z) \]

We detail the composition of each RC as well as the composition of the whole adjunct clause in the next sections.

\(^{11}\)For a detailed explanation and arguments in favor of this syntactic analysis, we refer the reader to Gonzalez and Lohiniva (2019).
3.2.1. Composition of RC₁

The first RC in (18) is a copular structure that contains the pronoun ce (‘it, that’) and the subjunctive copula soit. The question is, what type of copular clause are we dealing with? Higgins (1979) recognizes four types of copular clauses: predicational, specificational, equative, and identificational. The class of specificational copular clauses (19a) has been argued to also contain truncated clefts (19b), in which the subject is a pronoun (it or that) (Mikkelsen, 2007). Building on the clear parallel between truncated clefts and the structure of RC₁, we propose that RC₁ is also a specificational copular clause with a pronominal subject.

(19)  

a. The best runner is Zoé.  
    [Specificational copular clause]  

b. It is Zoé.  
    [Truncated cleft]  

c. Qui [RC₁ que ce soit it] ...  
    who REL it is.SBJ  

For Mikkelsen, the subject pronoun in truncated clefts is a property anaphor (type <e,t>). Just like any other pronoun, it must find its antecedent either in the linguistic context (20a) or the non-linguistic context (20b). In (20a), it is anaphoric to the set of people who make the best pies, and in (20b) to the set of people who are on the other side of the street.

(20)  

a. A: Who makes the best pies?  
    B: It is Zoé.  

b. *Looking at someone on the other side of the street:*  
    That might be Zoé.

(21) shows that within CUs, ce can also find its antecedent (here, the set of things that Zoé could be cooking) in the linguistic context (21a) or the non-linguistic context (21b).

(21)  

a. A: What is Zoé cooking?  
    B: Quoi que ce soit qu’elle cuisine, ...  
    what REL it is.SBJ REL-she cooks.SBJ  
    ‘Whatever she cooks, ...’

b. *Smelling an odor coming from the kitchen:*  
    Quoi que ce soit qu’elle cuisine, ...  
    what REL it is.SBJ REL-she cooks.SBJ  
    ‘Whatever she cooks, ...’

Thus, following Mikkelsen (2007), we analyze ce in RC₁ as a property anaphor. We modelize this property extensionally as \( \lambda x.D_w(x) \), where the set denoted by D is context-dependent. As a result, we obtain (22) as the meaning of the FCI wh que ce soit in our CU adjunct.
3.2.2. Composition of RC

Just like other FCIs, *wh que ce soit* FCIs appear in a limited set of environments (Muller, 2006; Vlachou, 2007; Corblin, 2010). For instance, they can occur in modal contexts (23a), but are usually not licensed in episodic statements (23b). To occur in episodic statements, they have to be modified by an RC (LeGrand, 1975; Dayal, 1998: among others), as shown in (23c). These episodic contexts in which FCIs are licensed have been called *subtrigging* environments.

(23) a. *Zoé peut lire quoi que ce soit.*
     Zoé can read what REL it is.SBJ
     ‘Zoe can read anything.’

b. *Zoé a lu quoi que ce soit.*
     Zoé has read what REL it is.SBJ
     ‘Zoe had read anything that could be relevant.’

c. *Zoé a lu quoi que ce soit qui puisse être pertinent.*
     Zoé has read what REL it is.SBJ REL can.SBJ be relevant
     ‘Zoe had read anything that could be relevant.’

In many Romance languages, the RCs modifying FCIs in subtrigging environments have to occur in the subjunctive mood.\(^{12}\) This is illustrated in (24) for Catalan: when the RC modifying the FCI *qualsevol* is in the indicative mood, the sentence is ill-formed (24a), but when the RC is in the subjunctive mood, the FCI *qualsevol* is licensed, and the sentence is well-formed (24b).

(24) Catalan (Quer 2000):

a. *Van felicitar qualsevol voluntari que *havia* participat en*  
   AUX to.congratulate any volunteer that have.IND participated in*  
   l'operació de rescat.*
   the.operation of rescue

b. *Van felicitar qualsevol voluntari que *hagués* participat en*  
   AUX to.congratulate any volunteer that have.SBJ participated in*  
   l'operació de rescat.*
   the.operation of rescue

   ‘They congratulated any volunteer that had taken part in the rescue operation.’

Similarly, in French CUs, the verb in RC₂ has to be in the subjunctive mood. (25) shows that the CU adjunct clause is not well-formed when it occurs in the indicative mood.

\[ (25) \]
\[
\begin{align*}
a. & \quad *Quoi\ que\ ce\ soit\ que\ Zoé\ fait. & \quad \ldots \\
& \quad \text{what REL it is.SBJ REL Zoé does.IND} \\
b. & \quad Quoi\ que\ ce\ soit\ que\ Zoé\ fasse, & \quad \ldots \\
& \quad \text{what REL it is.SBJ REL Zoé does.SBJ} \\
& \quad \text{'Whatever Zoé does, ... '} \\
\end{align*}
\]

The use of the subjunctive mood in subtrigging environments has been tied to the presence of a covert modal in the RC (Quer, 1998, 2000; Dayal, 2009; Chierchia, 2013). We follow Dayal (2013) in assuming that the relevant modal is a covert epistemic possibility modal quantifying over worlds that are compatible with the speaker’s beliefs. We thus obtain (26b) as the meaning of RC₂. Composing (26b) with the meaning of the FCI quoi que ce soit in (26c), we obtain (26d) as the meaning of the whole adjunct clause.

\[ (26) \]
\[
\begin{align*}
a. & \quad \left[ \text{CU-adjunct} \left[ Quoi_{j} \ [RC_{1}\ que\ ce\ soit\ t_{j}] \right] \right] \left[ RC_{2}\ que\ Zoé\ cuisine\ t_{j} \right], & \quad \ldots \\
& \quad \text{what REL it is.SBJ REL Zoé cooks.SBJ} \\
b. & \quad [RC_{2}] = \lambda y.\exists w' \in ACC_{w}(w')[cooks_{w'}(y)(z)] \\
c. & \quad \left[ Quoi_{j} \ [RC_{1}\ que\ ce\ soit\ t_{j}] \right] = \lambda Q.\exists x[D_{w}(x) \land Q(x)] \\
d. & \quad \left[ (26a) \right] = \exists x[D_{w}(x) \land \exists w' \in ACC_{w}(w') [cooks_{w'}(x)(z)]] \\
\end{align*}
\]

3.2.3. Exhaustification within the adjunct clause

We adopt an alternative-based approach to free choice (Chierchia, 2006; Fox, 2007; Chierchia, 2013; Dayal, 2013: among others). On this view, FCIs are existentials that obligatorily activate alternatives, and some FCIs like any and wh que ce soit acquire a universal interpretation through recursive exhaustification. In this section, we show how this is achieved.

First, an FCI like any has the same denotation as a plain indefinite (27a), but it also activates a set of domain alternatives (ALT) (27b). These alternatives consist of subsets of the relevant quantificational domain.

\[ (27) \]
\[
\begin{align*}
a. & \quad \left[ Quoi_{j} \ [RC_{1}\ que\ ce\ soit\ t_{j}] \right], & \quad \ldots \\
& \quad \text{what REL it is.IND REL Zoé does.SBJ} \\
\end{align*}
\]

For now, we tentatively propose that the modal establishes a syntactic relationship with any verbs below it, leading to SBJ-marking (e.g., Oikonomou, 2016). On this view, RC₁ contains a subjunctive verb because it is base-generated inside RC₂ which contains a modal.
Any active alternatives must be factored into meaning. One way to do this is by inserting the exhaustification operator $EXH$, akin to silent $\text{only}$, defined in (28). Given a sentence $\phi$ and a set of alternatives $\text{ALT}$ of $\phi$, $EXH \phi$ asserts the conjunction of $\phi$ and the negations of all alternatives that are not entailed by the assertion.

\begin{equation}
EXH^g_w(\phi) = \phi_w \land \forall p \in \text{ALT}(\phi) \; [p_w \rightarrow \phi \subseteq p]
\end{equation}

As mentioned above, with FCIs like $\text{wh que ce soit}$, exhaustification is recursive. First, the alternatives are themselves exhaustified through a process that is often called pre-exhaustification (Fox, 2007; Chierchia, 2013). The pre-exhaustified alternatives are then combined with the basic meaning via a second round of exhaustification. To illustrate, consider the CU adjunct clause in (29) and its basic meaning in (29a). For ease of presentation, we assume that $D$ contains only two members, $a$ and $b$. Given the connection between existential quantification and disjunction, the logical translation in (29a) can be rewritten as in (29b) using a disjunction.

\begin{equation}
\text{Alternatives for (29b)}:
\begin{align*}
a. \quad & [\exists x[D_w(x) \land \exists w' \in ACC_w(w') \; \text{cooks}_w'(x)(z)]] \\
b. \quad & [D_w(a) \land \exists w' \in ACC_w(w') \; \text{cooks}_w'(a)(z)] \\
& \lor [D_w(b) \land \exists w' \in ACC_w(w') \; \text{cooks}_w'(b)(z)]
\end{align*}
\end{equation}

The set of alternatives of a disjunctive statement contains each individual disjunct (Sauerland, 2004). Therefore, each disjunct in (29b) is an alternative of the assertion, as shown in (30). To refer back to these alternatives, we will use the abbreviations $A$ and $B$.

\begin{equation}
\text{Alternatives for (29b)}:
\begin{align*}
a. \quad & [D_w(a) \land \exists w' \in ACC_w(w') \; \text{cooks}_w'(a)(z)] \\
b. \quad & [D_w(b) \land \exists w' \in ACC_w(w') \; \text{cooks}_w'(b)(z)]
\end{align*}
\end{equation}

As previously mentioned, these alternatives have to be pre-exhaustified. This means that they are both conjoined with the negation of all other (non-entailed) alternatives, as shown in (31).
Pre-exhaustified set of ALT for (29b):

\[ \begin{align*}
\text{a. } & D_w(a) \land \exists w' \in \text{ACC}_w(w') \left[ \text{cooks}(w')(a)(z) \right] \land \neg D_w(b) \land \exists w' \in \text{ACC}_w(w') \left[ \text{cooks}(w')(b)(z) \right] = A \land \neg B \\
\text{b. } & D_w(b) \land \exists w' \in \text{ACC}_w(w') \left[ \text{cooks}(w')(b)(z) \right] \land \neg D_w(a) \land \exists w' \in \text{ACC}_w(w') \left[ \text{cooks}(w')(a)(z) \right] = B \land \neg A
\end{align*} \]

Then, because (29b) entails neither of the alternatives in (31), the second round of exhaustification conjoins the assertion with the negations of both pre-exhaustified alternatives (32).

\[(32) \text{ EXH to a pre-exhaustified set of ALT:} \]
\[ \text{EXH}([A \lor B]) = [A \lor B] \land \neg [A \land \neg B] \land \neg [B \land \neg A] = A \land B \]

As the conjunction of the two alternatives \( A \land B \) is equivalent to a universal statement, we derive the FC implicature in (33b) for the CU adjunct clause in (33a).

\[(33) \ a. \text{ Quoi que ce soit que Zoe cuisine.} \]
\[\text{que it soit.} \]
\[\text{SBJ que Zoe cuisine. Zoé cooks.} \]
\[\text{SBJ ...} \]
\[\text{'Whatever Zoé cooks, ...'} \]

(For all \( x \), if \( x \) is in \( D_w \), then there is a world \( w' \) that is epistemically accessible from \( w \) where Zoé cooks \( x \).)

Of course, one crucial piece of meaning is still missing from (33b); for (33a) to be felicitously uttered, Zoé has to cook something in the actual world. As things stand, (33b) does not guarantee this presupposition triggered by the \( \text{wh} \) or the FC as a whole, and leave the close investigation of this presupposition for future work. We deem this choice justified due to the fact that contrary to Rawlins (2013), our account of consequent entailment does not rely on the existential presupposition, but on the semantics of free choice, as we will show in section 5.2.

4. Viability and ignorance

4.1. Viability constraint

As mentioned in section 3.2.2, FCIs (including \( \text{wh que ce soit que Zoe cuisine.} \) have a restricted distribution: they can occur in modal contexts and are only licensed in episodic statements when subtrigged. Doyal (2013) argues that the restricted distribution of FCIs can be captured by assuming that a FCI is licensed only if its pre-exhaustified alternatives are viable (34).
(34)  a. An alternative $A$ is viable iff there exists a model $M$, a world $w$, and a conversational background $g(w)$ such that $A$ is true at $w$ w.r.t to some (non-empty) subset of $\cap g(w)$.
  
  b. Viability constraint: A FCI is licensed in a sentence $\phi$ iff all of the pre-exhaustified alternatives of $\phi$ are viable.

To illustrate how the viability constraint affects the licensing of $wh$ que $ce$ soit FCIs in CUs, consider again the adjunct clause in (35), its basic meaning in (35a), its pre-exhaustified alternatives in (35b), and the FC implicature it gives rise to in (35c).

(35) *Quoi que ce soit que Zoé cuisine,* ...

‘Whatever Zoé cooks, ...’

a. $\exists x[D_w(x) \land \exists w' \in ACC_w(w')[cooks_{w'}(x)(z)]]$  
   [Basic meaning]

b. $A' = A \land \neg B$  
   $B' = B \land \neg A$  
   [Pre-exhaustified alternatives]

c. $\forall x[D_w(x) \rightarrow \exists w' \in ACC_w(w')[cooks_{w'}(x)(z)]]$  
   [FC implicature]

d. $M_1$: $\cap g(w) = \{w_1, w_2\}$; $\forall w D_w = \{a, b\}$
   $Zoe.cooks = \{(w_1, \{a\}), (w_2, \{b\})\}$

   $w_1 \quad \{a\}$

   $w_2 \quad \{b\}$

Figure 1: Model $M_1$

In model $M_1$ (35d), the assertion in (35a) is true and every pre-exhaustified alternative in (35b) is false. That is, $M_1$ is a model in which the FC implicature given in (35c) arises. In addition, the pre-exhaustified alternatives $A'$ and $B'$ are both viable in $M_1$: there is a subset of $\cap g(w)$ that makes $[A' = A \land \neg B]$ true, namely, $\{w_1\}$, and there is a subset of $\cap g(w)$ that makes $[B' = B \land \neg A]$ true, namely, $\{w_2\}$. Given that both $A'$ and $B'$ are viable, the viability constraint in (34b) is satisfied. Thus, the FCI is licensed in the CU-adjunct clause in (35).

Next, we show how speaker ignorance in CUs follows from Viability.

4.2. Speaker ignorance

As discussed in sections 1 and 2.3, a core interpretational property of CUs is that they require speaker ignorance. For example, a speaker who utters (36) does not know whether Zoé will cook $a$ or $b$. We propose that the viability constraint in (34) is responsible for this inference. To show that this is the case, let us assume to the contrary that the speaker knows that Zoé will cook $a$ and $b$. Given that $\cap g(w)$ only contains worlds compatible with speaker beliefs at $w_0$, our new model $M_2$ (36b) only contains worlds where Zoé cooks $a$ and $b$. 

\[ A \text{ compositional semantics for free choice constituent unconditionals} \]
(36) _Quoi que ce soit que Zoé cuisine, ..._
what REL it isSBJ REL Zoé cooks.SBJ
‘Whatever Zoé cooks, ...’

a. Pre-exhaustified alternatives:
   \[ A' = A \land \neg B \]
   \[ B' = B \land \neg A \]

b. \[ M_2: \cap g(w) = \{w_1, w_2\}; \forall w D_w = \{a, b\} \]
   \[ Zoe.cooks = \{(w_1, \{a, b\}), (w_2, \{a, b\})\} \]

In model \( M_2 \), the assertion is true and every pre-exhaustified alternative in (36a) is false. That means that even though \( M_2 \) is a model in which the universal FC implicature arises, \( A' \) and \( B' \) are not viable in \( M_2 \) because there is no subset of worlds in \( \cap g(w) \) that makes \( A' \) true, and there is no subset that makes \( B' \) true.

Thus, in French CUs, speaker ignorance effects can be directly modeled as a consequence of the licensing conditions of FCIs.

5. Composition with matrix clause

In this final content section, we show how the CU adjunct clause is composed with the matrix clause to form a full CU using a standard Heim-Kratzer-Lewis semantics for conditionals. We also show that the second main interpretative property of French CUs – consequent entailment – results from the interaction of the viability constraint and the semantics of the conditional.

5.1. Conditional semantics

We propose that French CU adjuncts are conditional antecedents in the sense of standard conditional semantics (Heim, 1982; Kratzer, 1977; Lewis, 1975). Under this view, conditionals involve a covert necessity modal (\( \Box \)), and the adjunct clause provides the restrictor for it. This analysis is illustrated in (37) using the denotation of the exhaustified CU adjunct clause in (33b).

(37)

\[ \Box p. \lambda q. \forall w' \in ACC_w(w') \quad [p_{w'} \rightarrow q_{w'}] \]
\[ \lambda w. \forall x[D_w(x) \rightarrow \exists w' \in ACC_w(w')[cooks_{w'}(x)(z)]] \]

Composing \( \Box \) with the CU adjunct clause and the main clause, we obtain (38) at \( w_0 \).
∀w′ ∈ ACC\(_{w_0}(w')\) \\
[∀x[D\(_{w'}(x)\) → ∃w'' ∈ ACC\(_{w'}(w'')\)[cooks\(_{w''}(x)(z)\)]]

→ happy\(_{w'}(l)\)]

(38) (In all worlds \(w'\) epistemically accessible from \(w_0\), if it is the case for all \(x\) in \(D\) at \(w'\) that Zoe may cook \(x\) at \(w'\), then Lou is happy in \(w'\).)

We now want to ensure that the truth of the consequent \((q)\) is always entailed.

5.2. Consequent entailment

To derive consequent entailment, we must make sure that the antecedent of the conditional is always true. In other words, for (38), we must ensure that all \(x\) in \(D\) at \(w'\) are things that Zoe could cook in \(w'\). To see how this follows, we must go back and look at the semantics of the adjunct clause (sections 3.2.3 and 4.1). Recall that our adjunct clause can be rewritten as a conjunction of the two alternatives \(A\) and \(B\).

(39) 

\[D\(_w(a)\) ∧ ∃w' ∈ ACC\(_w(w')\)[cooks\(_{w'}(a)(z)\)] \land D\(_w(b)\) ∧ ∃w' ∈ ACC\(_w(w')\)[cooks\(_{w'}(b)(z)\)] = A ∧ B\]

The conjunction in (39) is true only if both conjuncts \(A\) and \(B\) are true. Note that the conjuncts themselves are modal, and require the existence of an accessible world where Zoe cooks something in \(D\). Crucially, the truth of both conjuncts is guaranteed by the viability constraint: both \(A ∧ ¬B\) and \(B ∧ ¬A\) have to be viable, which in turn means that there are accessible worlds \(w'\) in which only \(A\) is true (entailing the truth of \(A\)), and accessible worlds \(w'\) in which only \(B\) is true (entailing the truth of \(B\)). Thus, consequent entailment appears as a by-product of viability, just like speaker ignorance.

6. Conclusion

In conclusion, this paper presents a unified, fully compositional analysis of short and long CUs in French. We argue that underlyingly, both short and long CUs contain a *wh que ce soit* FCI, and derive short CUs through relative clause ellipsis. We use the presence of a FCI to explain two core interpretational properties of CUs, namely, consequent entailment and speaker ignorance. Our reliance on free choice in the analysis of CUs connects our work to previous work on Hungarian (Szabolcsi, 2019) and Dravidian (Balusu, 2019) unconditionals, and on free choice phenomena in Romance (Caponigro and Fălăuş, 2018).

In future work, we hope to detail the exact source of the existential presupposition that accompanies all CUs and unconditionals in general. Moreover, we wish to extend the analysis of French to CUs in other Romance languages, and Spanish and Portuguese in particular.

Overall, our work provides more evidence for the claim that unconditionals can be formed using various morphosyntactic and semantic ingredients across languages (Balusu, 2019; Šimík, 2019; Szabolcsi, 2019).
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Vowel quality and iconic lengthening
Janek GUERRINI - Département d’Études Cognitives, Institut Jean Nicod, École Normale Supérieure, EHESS, CNRS, PSL University.

Abstract. In spoken language it is possible to modulate the length of a given vowel in order to convey a strengthened meaning, e.g. in “loooong talk” the denoted talk is longer than in “long talk. This very same lengthening is not felicitous for adjectives like short (* “shooort”). For this reason, the lengthening of “large”-type adjectives like “long” is usually held to be purely iconic (Schlenker, 2016; Fuchs et al., 2019), i.e. the result of a direct mapping from, e.g., the length of the talk to the length of the word “long”. However, for adjectives like “teeny”, iconic lengthening seems to be possible. Consequently, I argue that to account for iconic modulation of vowel length it is necessary to consider, alongside ‘pure’ iconicity, the back/front opposition of vowels, one of the most robust phenomena linked to sound symbolism. I submit that two mechanisms underlie modulation of vowel length: i) ‘Pure’ iconicity, mapping the length (or number of replications) of the vowel directly onto the size of the object of which the adjective is predicated, thus applying to “large”-type words only. ii) Intensification of the vowel symbolism, placing restrictions on the lengthenable vowel requiring the vowel type (back/ front) to ‘match’ with the semantic direction of the adjective (“large”-type/“small”-type respectively). I present two pilot studies that test acceptability judgments on scalar adjectives whose stressed vowel has been lengthened. The studies are underpowered, but there is a consistent trend that goes in the direction of our predictions.

Keywords: iconic lengthening, vowel symbolism, iconic enrichments.

1. Introduction

In language, both spoken and signed, it is possible to modulate the length of a given sound or sign in order to convey a strengthened meaning, like in (1).

(1) I am normally rather patient. But if the talk is loooong, I'll leave before the end.

   $\Rightarrow$ if the talk is long, the speaker will leave before the end  
   $\Rightarrow$ if the talk is very long, the speaker will leave before the end.

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One semantic domain in which such modulations are particularly frequent is that of scalar adjectives. In formal semantics they have been analyzed as functions from individuals to degrees on scales (Bierwisch, 1987; Kennedy, 1999, 2007). This semantic class is a good place to test iconicity: sizes and scales are more easily mappable to dimensions of language like duration (spoken language) and amplitude (sign language) than other semantic areas. For instance, in Italian Sign Language adjectival scales can be iconically characterized in signing space (Aristodemo and Geraci, 2018).

2. A non-trivial interaction between iconic lengthening and vowel quality

The modulations of interest can target the at-issue component of the clause (Okrent, 2002; Schlenker, 2016). This is particularly clear with scalar adjectives, as remarked above. Prima facie, there seem to be two competing theories accounting for such vowel lengthening:

**Theory I. Intensification**: The length of the object to which “long” applies is smaller than the length of the object to which “looong” applies exclusively by reason of an intensification effect, similar to when “very” is repeated before an adjective to strengthen its meaning.

On this theory, lengthening works like stress in the traditional analysis. Kennedy (2007) linked prosodic stress to a systematically raised standard in all gradable adjectives. The scale associated with the scalar adjective tall is a height scale (Kennedy, 1999; 2007). The adjective communicates that its argument falls above (or below) some threshold on this scale. Consider (2):

(2) John is tall. [Understood meaning: The man's height is greater than a normal standard.]

Scalar adjectives are context-dependent. Thus if we speak of a basketball player, the threshold will be of something like 210 cm, the average height of basketball players. Scalar adjectives are also underspecified: while the scale is fixed in advance, the threshold and its precise value are not. Stress can be used to systematically strengthen the interpretation of gradable adjectives in both semantic directions (“small”-type and “large”-type) (Kennedy, 2007). When an adjective is under stress, depending on its semantic direction the standard of the adjective will be interpreted as especially high (as for example for “tall”) or low (for “short”):

(3) Bob is TALL.
(4) The watch is EXPENSIVE.

One can see that the effect is quite general, in that it appears whenever stress is applied to a lower- or upper-bounding adjective in a predicative setting².

However, **Theory I** is neither explanatorily nor descriptively adequate in that lengthening at least doesn’t seem to be as productive as word stress. Thus (5a) unlike (5b), is infelicitous.

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² There are of course many other readings of stress, such as contrast and correction, which do not concern us in this article.
(5) a. The talk was shooort. (Schlenker, 2016)
b. The talk was SHORT.

On these grounds, Schlenker (2016) suggests that a ‘pure’ version of iconicity might better explain modulation of vowel length:

**Theory II. Iconicity and direct mapping:** the length of the vowel, in virtue of its iconic effect, is a direct mapping of the length of the talk.

In other words, **every sound unit maps onto a signified extra size unit.** This seems to be confirmed by corpus studies. Fuchs et al (2019), for instance, examined 10 antonym pairs in an English social media corpus in order to investigate whether bloggers replicate letters more frequently in adjectives associated with a greater size or spatial/temporal extent. Among the antonyms compared, it was always the “large”-type adjective that featured more letter replications. The study did not find any effect of sound symbolism on lengthening in the antonym pairs. In sum, the results of Fuchs et al. (2019) seem to point in the direction of ‘pure’ iconicity.

However, **Theory II** cannot explain the data in (6a) and (6b), since ‘pure’ iconicity predicts that it should not be possible for the length of a vowel to be *inversely* proportional to the size of the denoted object.

(6) a. **ENG** That mouse is teeeeny.
    b. **ITA** Quel topo è piiiccolo.³

Given the data so far reviewed, one hypothesis worth investigating is that the conditions of felicity of iconic lengthening and the quality of the lengthened vowel interact non-trivially. In this connection, note the difference in felicity between (5a) and (6a).

There is indeed a large set of sound-meaning associations generally described as sound symbolism. One of the most robust among these is the connection between back vowels and words semantically related to largeness, and similarly for front vowels and smallness. Already Köhler (1929) argued that given the pair of words *takete* and *baluma, takete* will be typically associated with sharp shapes, whereas *baluma* will match with blob-like features. He linked this to the difference between back and front vowel. Sapir (1929) corroborated this intuition, showing that English speakers agree to a large extent when comparing non-words that differ exclusively in the back vs front character of the vowel, e.g. in considering [gɔl] to be larger than [gil].

Since Sapir, the back/front opposition and the related symbolism have been investigated at length. To cite only a few studies, Thomson and Estes (2001) showed that the size-vowel height link is a graded function: in a task of naming of novel objects, the size of the object linearly predicted the number of back-vowel phonemes in its preferred name. Cross-linguistic work has

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³ Italian data are drawn from my introspective judgments and discussions with three other native speakers.
established strong back/front large/small trends in a large number of existing languages and across unrelated families (Johnson, 1967; Ohala, 1984; Ultan, 1978).

Coming back to iconic lengthening, how might the proposed interaction with vowel quality take place? At first glance, one might think that because of the felicity of (6a) and (6b), an intensification of the vowel symbolism suffices to explain the data. In other words, iconic lengthening might intensify the effect of the vowel symbolism equally and in both directions. The felicity of (6a) in the face of the infelicity of (5a) militates in favor of this hypothesis. Moreover, “looong” in (7a) seems introspectively more felicitous than “thiiick” in (7b).

(7) a. This talk is looong.
   b. This slice is thiiick.

However, precisely these two facts highlight an asymmetry. Iconically lengthening the back vowel in “small”-type adjectives makes the sentence infelicitous. On the other hand, the lengthening of the front vowel in “large”-type adjectives does not affect the felicity of the sentence (7b): it is merely less felicitous than the lengthening of the back vowel as in (7a).

<table>
<thead>
<tr>
<th></th>
<th>Words with back vowel as stressed vowel</th>
<th>Words with front vowel as stressed vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>“large”-type</td>
<td>Felicitous</td>
<td>Felicitous, but less than “large”-type × back vowel.</td>
</tr>
<tr>
<td>“small”-type</td>
<td>Infelicitous</td>
<td>Felicitous</td>
</tr>
</tbody>
</table>

“Biiig” seems to be better than “shooort”, although neither seems to feature any symbolism (big is a “large”-type × front vowel, short a “small”-type × back vowel). The overall higher acceptability of lengthening in ‘long’-type words creates an asymmetry that calls for a mixed theory.

I submit that two mechanisms underlie modulation of vowel length:

- **Pure iconicity** maps the length (or number of replications) of the vowel directly onto the size of the object of which the adjective is predicated, thus applying to “large”-type words only. This is the mapping in which a longer realisation of the vowel denotes a smaller intended meaning is an inverse one.

- **Iconic intensification** places restrictions on the lengthenable vowel requiring the vowel type (back/ front) to ‘match’ with the semantic direction of the adjective (“large”-type/ “small”-type respectively). This is not intensification of the conventional Kennedy-type focus meaning (i.e., the standard is always raised in “large”-type adjectives and lowered in “small”-type adjectives), but rather intensification of the sound symbolism, i.e., of the vocal gesture that produces the sound.

<table>
<thead>
<tr>
<th></th>
<th>Back vowel as stressed vowel</th>
<th>Front vowel as stressed vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>“large”-type</td>
<td>Pure iconicity</td>
<td>Pure iconicity</td>
</tr>
<tr>
<td></td>
<td>+ iconic intensification</td>
<td></td>
</tr>
<tr>
<td>“small”-type</td>
<td>Ø</td>
<td>Iconic intensification</td>
</tr>
</tbody>
</table>
Table 1: Outline of our hypothesis: sub-mechanisms at work in the four conditions vowel-type (back/front) × word-type ("large"/"small").
- ‘large’-type × back vowel: ‘pure’ iconicity is involved because a direct mapping from the length of the word to the size of the predicated object is possible. Moreover, iconic intensification applies because back vowels symbolically correspond to bigger meanings. I expect this to be the most acceptable condition for lengthening.
- ‘large’-type × front vowel: ‘pure’ iconicity is involved, for the same reasons as above. Iconic intensification does not apply because vowel type and meaning do not match. I expect average acceptability.
- ‘small’-type × front vowel: no pure iconicity is involved: the longer the word, the *smaller* the referred object. Iconic intensification applies because front vowels symbolically match with “small”-type meanings.
- small-type × back vowel: no pure iconicity applies for the same reasons as above, and no vowel-meaning match. I expect the acceptability to be lowest in this condition.

The predictions can be laid out precisely:
- The “large”-type × back vowel condition should elicit higher acceptability judgments than the “large”-type × front vowel condition:
  Pure iconicity + iconic intensification > Pure iconicity
- The “large”-type × back vowel condition should elicit higher acceptability judgments than the “small”-type × front vowel condition:
  Pure iconicity + iconic intensification > Iconic intensification
- The “large”-type × front vowel should elicit higher acceptability judgments than the “small”-type × back vowel condition:
  Pure iconicity > Ø
- The “small”-type × front vowel should elicit higher acceptability judgments than the “small”-type × back vowel condition:
  Iconic intensification > Ø

3. Early pilots

I report two small, early pilots to support the above reported introspective judgments. In Pilot 1, participants were 14 native speakers of Italian aged 19-50 recruited from my social circle. Subjects had to give acceptability judgements from least acceptable” to 7 “most acceptable”, for 28 written adjectives (corresponding to 14 couples of antonyms) whose tonic vowel was iterated three times. In Pilot 2, participants were 15 Italian native speakers aged 19-65 equally recruited from our social circle. Subjects had to give acceptability judgements from 1 to 7 for 28 audio recordings (the adjectives corresponded to 14 couples of antonyms) whose tonic vowel was pronounced lengthened. Order was randomized for all subjects in both pilots. I predicted two main outputs: 1) that, overall, the acceptability judgements on “large”-type words outscore those on “small”-type words, 2) that vowels with a symbolism going in the semantic direction of the adjective (back vowels and “large”-type, front vowels and “small”-type) could be intensified with significantly higher acceptability than those going in the opposite direction. More specifically, where possible, I provided controls for the vowel quality:
synonyms featuring a different vowel type (back/front) were provided in order to provide insight in the variation within the same semantic area (see Appendix 1).

Descriptive statistics show higher overall acceptability judgements for lengthening of “large”-type adjectives in both the written and the spoken test (cf. Graph 1-4 in Appendix 1 for average acceptability of specific words). Moreover, prosodic lengthening in spoken language received overall higher judgements than written letter replication. Likewise, results showed higher acceptability judgements for lengthening when vowel and meaning “matched”, both in “large”-type and “small”-type direction.

Pilot 1 (written test)

<table>
<thead>
<tr>
<th>Type</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>large'-type x back</td>
<td>High</td>
</tr>
<tr>
<td>large'-type x front</td>
<td>Moderate</td>
</tr>
<tr>
<td>small'-type x back</td>
<td>Low</td>
</tr>
<tr>
<td>small'-type x front</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Pilot 2 (spoken test)

<table>
<thead>
<tr>
<th>Type</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>large'-type x back</td>
<td>High</td>
</tr>
<tr>
<td>large'-type x front</td>
<td>Moderate</td>
</tr>
<tr>
<td>small'-type x back</td>
<td>Low</td>
</tr>
<tr>
<td>small'-type x front</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

With respect to the predictions laid out in section 2, two observations are in order.

i) Lengthening in “large”-type words received globally higher acceptability judgments.

ii) Stressed vowel lengthening received higher acceptability judgements when vowel and meaning “matched” compared to when vowel and meaning did not match.
Thus being in line with the predictions of my two-factor theory: the sub-mechanism of ‘pure’ iconicity explains i) while iconic intensification explains ii).

These results are not generalizable. The design was bound to be unbalanced, as there are much fewer items in the condition “large”-type × front vowel than in the condition “large”-type × back vowel. Moreover, there are fewer items in the condition “small”-type × back vowel than in the condition “small”-type × front vowel. One way of controlling for this in future research would be to configure the experiment as a novel naming task, which already proved very useful in works like Thomson and Estes (2001).

4 As already mentioned, the unbalanced lexical distribution seems to be crosslinguistically linked to the symbolism itself. (See Johnson, 1967; Ohala, 1984; Ullan, 1978).

4. Iconicity, symbolism, and meaning-relevance

The iconic effect behind the back/front opposition has been claimed to arise in virtue of the relative position of palate and tongue (close in the case of front vowels, apart in the case of back vowels) and “by the spatial or dimensional meaning of these speech sounds” (Fischer, 1999). In other words, the bodily movement producing the vowel preserves some structural properties of the object to which the word containing the vowel refers, just like iconic lengthening does.

Why is lengthening so strikingly more productive than quality-related symbolism? Vowel length displays arbitrary productiveness and a mapping onto a continuous scale, whereas vowel quality as a semantic intensification strategy exhibits limited productivity and categorical perception due to the categorization of allophones in the same phonemic categories. This results in a mapping onto a discrete scale: /i/ maps broadly onto small things, while /a/ maps onto big things. A reasonable hypothesis, to be tested in future research, is that this difference can be boiled down to phonemic meaning-relevance. In Italian and English vowel length is not meaning-relevant, while vowel quality is. I submit that this explains the category constraints found within vowel symbolism. For instance, the vowel in “big” can be productively lengthened to “biiig” to raise the standard of the predicated bigness. But for this same purpose the vowel cannot be made more back: “bag” is just a different word. Thus knowing the meaning-relevant phonetic features of a language might make it possible to predict the productivity of iconic lengthening and of (at-issue) vowel symbolism.

5. Conclusion

In this paper, I argued that ‘pure’ iconicity is not enough to account for iconic lengthening, on grounds of the observation that the felicity of prosodic lengthening seems to interact non-trivially with vowel quality (e.g. *shooort vs OK teeny). More specifically, I have suggested that there are two mechanisms at work: ‘pure’ iconicity, a direct mapping from the length of the vowel to the size of the object referred to by the adjective, and intensification of the sound symbolism, which associates back vowels to “large”-type meanings and front vowels to “small”-type meanings. I have presented two small, early pilots whose results, although not generalizable, support my introspective judgments and are in line with the predictions of my two-factor theory.
References


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Okrent, Arika: (2002), A modality -free notion of gesture and how it can help us with the morpheme vs. gesture question in sigh language linguistics, or at least give us some criteria to work with. In R.P. Meier, D.G. Quinto-Pozos, & K.A. Cormier (eds). Modality and structure in signed and spoken languages (pp. 175-198). Cambridge: Cambridge University Press.


## APPENDIX 1: PILOT MATERIALS

### Antonym pairs

<table>
<thead>
<tr>
<th></th>
<th>English transl.</th>
<th>[-]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luuungo</td>
<td>long/short</td>
<td>Cooorto</td>
</tr>
<tr>
<td>Graaande</td>
<td>big/small</td>
<td>Piiccolo</td>
</tr>
<tr>
<td>Graaasso</td>
<td>fat/skinny</td>
<td>Smiiilzo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Striminziito</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maaagro</td>
</tr>
<tr>
<td>Meeega</td>
<td>mega/micro</td>
<td>Miicro</td>
</tr>
<tr>
<td>Giiiga</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grooosso</td>
<td>thick/thin</td>
<td>Sottiile</td>
</tr>
<tr>
<td>Lontaano</td>
<td>far/close</td>
<td>Viciiino</td>
</tr>
<tr>
<td>Laaargo</td>
<td>broad/narrow</td>
<td>Streeetto</td>
</tr>
<tr>
<td>Leeento</td>
<td>slow/fast</td>
<td>Sveeelto</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veloooce</td>
</tr>
<tr>
<td>Aaalto</td>
<td>high/low</td>
<td>Baaasso</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enooorme,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gigantrooopico,</td>
<td>enormous/teeny</td>
<td>Picciino Picchiiino</td>
</tr>
<tr>
<td>Gigaaante</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 2: DESCRIPTIVE STATISTICS

Pilot 1

Graph 1: [+] adjectives
Graph 2: [-] adjectives

-平均
-大
-紧张
-瘦
-啤酒
-瘦
-啤酒
-短
-薄
-瘦
-薄
-短
-薄
-薄
-薄
-小
-短
-薄
-薄
-薄
-薄
Pilot 2

Graph 3: [+] adjectives exp #2

Graph 4: [-] adjectives exp #2
Explicit comparison in Fijian
Emily A. HANINK — The University of Manchester

Abstract. Across languages, comparative constructions vary according to whether they are morphologically explicit or implicit, a cut based largely on the availability of a degree morpheme corresponding to English -er/than (Kennedy, 2007). Based on diagnostics from that work, it has been claimed that Fijian comparatives are always of the implicit type and, more strikingly, that the language therefore lacks degrees in its ontology (Pearson, 2009). I argue that neither of these are the correct conclusions to be drawn for Fijian. First, Fijian does in fact make use of an explicit comparative that makes use of a dedicated degree morpheme. Second, Fijian passes a variety of diagnostics for degreefulness that are not specific to comparatives, but whose presence are generally believed to require degrees in their semantics (Beck et al., 2009). In addition to presenting these arguments for the status of Fijian as a degreeful language, I also propose a preliminary direct phrasal analysis to account for the language’s explicit comparative.

Keywords: explicit vs. implicit comparison, degrees, DSP, phrasal comparatives, Fijian.

1. Introduction

Across languages, comparatives vary according to whether they are explicit or implicit (Kennedy, 2007). Explicit comparison on the one hand refers to comparatives that make use of dedicated comparative morphology, e.g., synthetic -er or analytic more in English. This type of comparative is the best studied in the literature, and is exemplified through the Hungarian in (1).

(1) István magas-abb [ mint Péter ].
Istvan tall-CMPR than Peter
‘Istvan is taller than Peter.’ (Stassen, 1985: 46)

On the other hand, implicit comparison refers to constructions in which no dedicated comparative morphology is used to give rise to a comparative meaning. Kennedy (2007) offers examples of the following form in English, in which no comparative morphology is employed:

(2) Compared to Lee, Kim is tall. (Kennedy, 2007: 17)

Cross-linguistically, implicit comparison is often found in the form of conjoined comparatives (Stassen, 1985), which are formulated such that some property is ‘true of x and false of y.’ Washo (Hokan/isolate; USA) is one language that makes use of this strategy, as shown in (3):

(3) dawp’ápíl de-?il-léleg-i? Mí:gi-?áñaw-i?-i?
flower NMLZ-ATTR-red-ATTR 3.look-good-ATTR-IND
NMLZ-ATTR-yellow-ATTR 3.look-good-ATTR-NEG-REP-DS

‘The red flower is prettier than the yellow one.’
(Bochnak, 2013: 164)

1I thank Eroni Lomata, who is the source of any unsourced Fijian data. I also thank Andrew Koontz-Garboden, Ryan Bochnak, Margit Bowler, Vera Hohaus, and Lisa Matthewson for helpful discussions, as well as the audiences at Sinn und Bedeutung 24 in Osnabrück and the 2019 LAGB meeting at QMUL. This work is supported by European Research Council Consolidator Grant ERC-2017-COG 769192 (P.I. Andrew Koontz-Garboden).

2Terminology adopted from Sapir (1944).

Notably, comparative type has often been invoked to inform on the status of degrees in the ontology of a language, with a broad assumption in the literature that the use of explicit comparison correlates with the existence of degrees in the construction. The flipside of this is that implicit comparison has been argued to correlate with a lack of degrees in the language altogether (Motu, Beck et al., 2009; Washo, Bochnak, 2015; Warlpiri, Bowler, 2016). The starting point for this observed correlation is that the presence or absence of degrees in the ontology of a given language has been independently proposed to be a parameter cross-linguistically:

### (4) **Degree Semantics Parameter**

A language {does, does not} have gradable predicates (type \(d, \langle e, t \rangle\) and related), i.e. lexical items that introduce degree arguments. (Beck et al., 2009: 19)

Crucially, languages proposed to lack degrees (i.e., [-DSP] languages according to Beck et al.’s 2009 terminology) seem to be rare, and therefore constitute important test cases for evaluating the reach of this parameter. In a direct contribution to this ongoing discussion, Pearson (2009) proposes that Fijian (Oceanic) has implicit comparison, and is accordingly [-DSP]. Her claims are i) Fijian is an implicit comparison language; ii) even though Fijian passes some tests for degreefulness, this is misleading; and iii) Fijian is another example of a [-DSP] language.

In what follows, I argue against each of these conclusions. To do this, I first show that Fijian comparatives are explicit in their morphosyntactic properties, though Fijian does have an altogether separate implicit comparative. Second, I show that Fijian makes use of degrees, evidenced both in that its comparatives pass Kennedy’s tests for degreeful comparison and in that other constructions in Fijian signify the presence of this semantic type. Finally, I provide a brief and preliminary direct account of Fijian comparatives along the lines of Potsdam (2011) and Bhatt and Takahashi (2011), which follows from syntactic restrictions on the standard marker.

### 2. Explicit comparatives in Fijian

Fijian is an Oceanic language with approximately 400,000 native speakers in Fiji. The neutral word order of the language is VOS/VSO (Dixon, 1988). The primary strategy for comparison in Fijian is shown in (5), where the gradable predicate is marked in bold and the standard of comparison is marked in italics. In such comparatives, the form of the adjective may be bare (e.g., *bibi* ‘heavy’), and the standard of comparison follows the preposition *mai* ‘from’ (constituting a ‘separative’ comparative in the terminology of Stassen, 1985):

### (5) Na vatu oqo e bibi [ mai na vatu ogori ].

ART rock this 3.SG heavy from ART rock that

‘This rock is heavier than that rock.’

I begin with the question of how this type of comparative fares with the explicit vs. implicit distinction described by Kennedy (2007). According to Kennedy’s description, explicit comparison languages are identified on morphosyntactic grounds, based on the existence of a dedicated comparative morpheme corresponding to English *-er/more*. This is described in (6):

**3**Though see Bochnak (2015) for some problems for this correlation, with specific reference to Motu.

**4**Glosses: ART: article (van Urk, 2019), DIR: directional, INTNS: intensifier, PN: proper name marker. Unless otherwise noted, data come from the author’s elicitation sessions with a native speaker from Suva.

**5**When this preposition precedes a proper name, it is expressed alongside another directional marker as mai-vei.
Explicit comparatives
Establish an ordering between objects \(x\) and \(y\) with respect to gradable property \(g\) using a morphosyntactic form whose conventional meaning has the consequence that the degree to which \(x\) is \(g\) exceeds the degree to which \(y\) is \(g\). (Kennedy, 2007: 16)

Implicit comparison languages are conversely identified by the lack of a dedicated comparative morpheme, as described in (7):

Implicit comparatives
Establish an ordering between objects \(x\) and \(y\) with respect to gradable property \(g\) using the positive form by manipulating the context in such a way that the positive form is true of \(x\) and false of \(y\). (Kennedy, 2007: 16)

Crucially here, Pearson (2009) argues that, according to (7), Fijian is an implicit comparison language, as there is no comparative morpheme in examples such as (5). However, it is important to note that while there is no obligatory -er/more, this does not rule out potentially silent comparative morphology: Optional comparative morphemes are found cross-linguistically, e.g., in certain contexts in Hindi (8) and across the board in Malagasy (9) (see also Samoan (Hohaus, 2015); Hebrew (Schwarzschild, 2014); Nez Perce (Deal and Hohaus, 2019)).

(8) Atif [ Boman-se ] (zyaadaa) lambaa hai.
\(\text{Atif} \quad \text{Boman-from} \quad \text{more} \quad \text{tall} \quad \text{is} \quad \text{‘Atif is taller than Boman.’} \quad \text{Hindi; (Bhatt and Takahashi, 2011: 591)}

(9) Lava (kokoa) [ noho ilay zaza ] Rabe.
\(\text{long} \quad \text{more} \quad \text{than} \quad \text{that} \quad \text{child} \quad \text{Rabe} \quad \text{‘Rabe is taller than that child.’} \quad \text{Malagasy; (Potsdam, 2011: 140)}

Crucially, Fijian likewise makes use of an optional morpheme cake as in (10), literally ‘up/above’, which can be translated in comparatives as ‘more’ (see also Milner, 1976).\(^6\)

(10) E katakata cake ’o Viti [ mai-vei Peritaania ].
3.5G hot more PN Fiji from-DIR.PN Britain
\(\text{‘Fiji is hotter than Britain.’} \quad \text{While Pearson does not address data with cake, I argue here that the availability of this morpheme in the separative comparative places Fijian squarely in the category of languages with comparative morphology, i.e., explicit comparison languages.} \text{7}

It is important moreover that Fijian likewise makes use of an additional, implicit comparative of the conjoined type, exemplified in (11). This type of comparative differs clearly from the explicit type introduced above in that it involves conjunction, and fits the description in (6).\(^8\)

\(^6\)Likewise cited by Dixon (1988) for Boumaa Fijian, a different variety.

\(^7\)I also note that this description of explicit comparison puts all the semantic work of the comparative into the comparative morpheme itself. There have however been recent arguments that the standard marker, in this case mai ‘from’, also plays a semantic role in comparison (see Alrenga et al., 2012). Such a view calls into question the classification of explicit comparison languages according to the presence of a comparative morpheme alone.

\(^8\)Comparatives of this type are accepted but dispreferred by my consultant, who finds them antiquated.
In light of the availability of the comparative morpheme *cake*, in conjunction with the existence of an independent implicit comparative, Pearson’s claim that Fijian lacks explicit comparison becomes untenable. As hinted at in the introduction however, Pearson takes this claim further and argues that Fijian is a degreeless language based on the absence of an explicit comparative.

Importantly, the existence of *cake* does not immediately rule out a degreeless analysis, the second part of Pearson’s claim. The explicit vs. implicit distinction is a morphosyntactic one, and therefore does not immediately tell us about the status of degrees in the ontology of a language; this correlation is often implicitly assumed (e.g., in Kennedy, 2007), but not necessarily warranted. In the next section, I summarize the logic behind this assumed correlation before turning to the semantic tests that lend support to the presence of degrees in the Fijian.

### 3. Degrees in the ontology

The proposed correlation in the literature between the explicit/implicit distinction and degreefulness often draws its logic from the availability of both degreeful and degreeless analyses of gradable predicates. The basic idea is that languages with explicit comparison have adjectives that should be analyzed with a degree semantics, while those with implicit comparison have degreeless gradable predicates and, as a result, exhibit different morphosyntactic behaviors. In a nutshell, the lack of degrees in the semantics translates to a lack of degree morphology.

#### 3.1. Degreeful analyses of explicit comparison

One of the most widely adopted analyses of gradable predicate meanings invokes degrees by necessity in the ontology (i.a. Cresswell, 1977; von Stechow, 1984; Heim, 1985; Kennedy and McNally, 2005). On this type of analysis, a gradable predicate is a relation between individuals and degrees, of type \( \langle d, \langle e, t \rangle \rangle \) (where \( \text{tall}(x) \) refers to \( x \)'s height):

\[(12) [\text{tall}]: \lambda d, \lambda x, [\text{tall}(x) \geq d]\]

Degrees are ordered along some measurement scale, e.g., in (12), a scale of tallness. The comparative morpheme then makes use of the degree variable introduced by the adjective in establishing an ordering between two maximal degrees along the measurement scale, as in (13):

\[(13) [\text{more}]: \lambda P_{\langle d, t \rangle}, \lambda Q_{\langle d, t \rangle}, [\text{MAX}(Q) > \text{MAX}(P)]\]

Following this analysis, the comparative in (14a) will then be assigned the meaning in (14b):

\[(14)\]

a. Sarah is taller than Mary.

b. \( \text{MAX}(\lambda d, \text{tall}(\text{Sarah}) \geq d) > \text{MAX}(\lambda d', \text{tall}(\text{Sarah}) \geq d') \)

On the degree-based analysis of comparatives, degrees are required to establish the height (in this case) of one individual relative to the height of another, along an ordered scale of measurement. On this analysis, degrees are inherent to the meaning of gradable predicates, and may be manipulated by degree morphemes such as *more* to give rise to a comparative meaning.
3.2. Degreeless analyses of implicit comparison

A prominent alternative to degree-based analyses of gradable predicates is the vague predicate analysis (Kamp, 1975; Klein, 1980; van Rooij, 2011a). On this view, gradable predicates do not make reference to degrees but are contextually-determined sets of individuals, of type \( \langle e, t \rangle \).

\[
[[\text{tall}]]^c: \lambda x, e[\text{tall}(x) \text{ in } c]
\]

On this view, comparatives then existentially quantify over possible values of \( c \) without making reference to any ordering along a scale, as in (16) (modified from Bochnak, 2013: 53):

\[
[[\text{Sarah is taller than Mary}]]: \exists c[\text{tall}(\text{Sarah}) \text{ in } c \& \neg \text{tall}(\text{Mary}) \text{ in } c]
\]

The relative heights of Sarah and Mary are determined not with reference to orderings of degrees, but through context. The proposition in (16) will therefore be true in any context in which Sarah counts as tall, and Mary does not. On this analysis, gradable predicates do not introduce degrees, and comparative morphology simply relates these predicates to a particular type of context (Klein, 1980; see also Deal and Hohaus, 2019).

3.3. Connection to the explicit vs. implicit distinction

Returning to the explicit vs. implicit distinction, the connection between comparative type and degreefulness finds its roots in the basic idea that degree morphology is parastic on degree variables in the semantics. The comparative morpheme is one such instance of this degree morphology, leading to degree-based analyses of explicit comparison languages. If on the other hand implicit comparison languages are degreeless, then the lack of degrees removes the possibility for degree morphology, explaining why such languages lack comparative morphemes.

It is by this logic that Pearson (2009) analyzes Fijian as degreeless: Fijian lacks an explicit comparative, as it lacks MORE, and is accordingly a [-DSP] language. Following many authors, Pearson proposes a modified vague predicate analysis à la Klein. The problem with this logic is that morphosyntax does not tell us everything; there are problems for the implicitly assumed correlation between the type of comparative a language employs and whether it makes use of degrees (see also Bochnak, 2015). When evaluating whether a language lacks degrees, semantic tests are therefore crucial in addition to any morphosyntactic classification.

4. Semantic diagnostics for degreefulness

In this section I show that Fijian passes tests for degreefulness both from comparatives specifically as well as from language-wide diagnostics summarized by Beck et al. (2009), providing evidence against the classification of Fijian as a degreeless language.

---

9 Whether an individual counts as \textit{tall} in a context is established through a partitioning of the domain into individuals that are \textit{tall}, \textit{not tall}, or \textit{neither}.

10 While the vague predicate analysis was proposed originally for English and not implicit comparison \textit{per se}, it has been adopted by many authors to account for this comparative type (e.g., Beck et al. 2009, Bochnak 2015, Bowler 2016). Though see Deal and Hohaus (2019) for a degreeless analysis of explicit comparatives in Nez Perce).
4.1. Tests from comparatives

Kennedy (2007) provides tests for the presence of degrees in comparatives (s.a. Bochnak, 2015). His tests are based on the comparison strategies in English shown in (17a-b), which I will compare to data from Fijian throughout this section.

(17)  

a. Kim is taller than Lee. \textit{Explicit comparison}

b. Compared to Lee, Kim is tall. \textit{Implicit comparison}

The tests Kennedy provides come from i) differential comparatives; ii) absolute standard adjectives; iii) crisp judgments; and iv) negative implicatures to the positive form. Below, I show that Fijian passes these tests (though I do not discuss (iv)).\footnote{Pearson (2009) addresses other tests that I do not discuss here, as the judgments were all rejected by my speaker.} Along the way, I compare data from my consultant not only to English but also to the data presented by Pearson (2007). In some cases, the judgments differ, an issue I return to in Section 4.4.

4.1.1. Differential comparatives

The first test for degreefulness comes from differential comparison, exemplified in (18).

(18) John is \textit{six inches} taller than Mary.

The relevance of this test is that measurement along a scale is a hallmark of degrees (see also Deal & Hohaus 2019), which is found precisely in differential measure phrases like \textit{six inches}.

While Pearson (2009) treats the test for differential comparatives to be a \textit{syntactic} one – on the assumption that the measure phrase occupies the specifier of DegP (e.g., Schwarzschild, 2008), which requires the presence of Deg – this diagnostic is crucially better understood as a \textit{semantic} test, in that differential comparatives require some notion of \textit{degree measurement} along the lines of (19) (from von Stechow, 1984, adopting the proposal in Hellan, 1981):

(19) $\exists d_1, d_2, d_3 [\text{John is } d_1\text{-tall } \& \text{ Mary is } d_2\text{-tall } \& d_1 = d_2 + d_3\text{-tall } \& d_3 = 6 \text{ inches}]$

In (19), the measure phrase \textit{6 inches} is treated as degree-denoting. Such measurement phrases pose a problem for the vague-predicate analysis, which does not invoke the presence of degrees, and which therefore has difficulty in capturing addition along an ordered scale (though see van Rooij, 2011b for a degreeless treatment).

The prediction from this test is then that only degreeful comparatives allow for differential comparatives. This is borne out in English:

(20)  

a. Kim is 10cm taller than Lee. \textit{Explicit}

b. ??Compared to Lee, Kim is 10 cm tall. \textit{Implicit}

Fijian comparatives also license differential measure phrases, shown in (21) and (22):

(21) ‘o Meri e qase [ mai-vei Pita ] e \textit{na dua na yabaki}.

   PN Mary 3.SG old from-DIR.PN Peter 3.SG ART one ART year

   ‘Mary is one year older than Peter.’ (Pearson, 2009: 361)
While Fijian passes this particular test, Pearson (2009) argues that a degreeless language could in principle encode differential measure phrases by means of an adjunct by-phrase like that in (23), and therefore rejects this test as evidence for degrees in Fijian.

(23) Peter missed the target by 2cm. (Pearson, 2009: 365)

Pearson offers an analysis that makes use of a measure function as well as a relational variable R relating the measure phrase to the subject of the predicate. As the examples in (21)-(22) show, the position of the measure phrase in Fijian is not an obvious one of a measure phrase in specifier position, given the absence of an overt comparative degree head. However, this test does not rest on syntactic grounds alone: Schwarzschild (2008) argues for example that by-phrases along the lines of (23) are another type of degree modifier and are not in fact degreeless, meaning that a syntactic location in Spec, DegP is not a necessary condition for the existence of differential measure phrases. If we adopt a degreeful analysis for Fijian, it is no longer a mystery why Fijian allows differential measure phrases, and no extra machinery is required.

4.1.2. Crisp judgments

The second test comes from crisp judgment contexts, which involve comparison of two objects that are very (and possibly imperceptibly) close in measurement. This particular test targets the inherent vagueness of gradable predicates: When two objects are very close in measurement along some scale, the predictions vary for degreeful vs. degreeless accounts. This test draws on a crucial property of gradable adjectives: vagueness. That gradable adjectives are vague can be seen in the following contrast, in which what counts as tall depends on the context:

(24) Maria is 5’8”/173 cm tall.
   a. Context: A group of women of average height
      Mary is tall.
   b. Context: A group of women in the WNBA
      #Mary is tall.

On degree-based accounts, vagueness effects are the result of POS, a silent morpheme that gradable adjectives must compose with in order to become predicates. Crucial here is the fact that the meaning of an adjective on its own is not vague (26a), but inherits a context-sensitive meaning only after combining with POS, as in (25):

(25) [[POS]]: \( \lambda g_{(d, (e, I))} \lambda x. \exists d [d > s_{G} & G(d)(x)] \) (Bochnak, 2015: 63)

In (25), \( s_{G} \) is the contextual standard for \( G \), which varies according to the appropriateness of the context when an adjective is used in its positive form, giving rise to the observed vagueness effects. The derivation for the combination of an adjective like tall with POS is shown in (26), which demonstrates that the vagueness of adjectival predicates is captured entirely by composition with POS:
In the case of comparatives the other hand, vagueness is never introduced, as the gradable predicate composes with COMP rather than POS (the comparative is not built on the positive form). Crucially, no vagueness is built into the meaning of COMP; the comparative requires only an asymmetric ordering of maximal degrees along some scale (repeated from (14b)):

\[ ([\text{Sarah is taller than Mary}]) : \max(\lambda d. \text{tall}(\text{Sarah}) \geq d) > \max(\lambda d'. \text{tall}(\text{Sarah}) \geq d') \]

On the vague predicate analysis by contrast, vagueness is always present, as context sensitivity is built into the meaning of the predicate itself, and is not introduced by a POS morpheme:

\[ ([\text{tall}])' : \lambda x.e[\text{tall}(x) \text{ in } c] \]

Because gradable predicates are always vague, this means that vagueness should persist in comparatives, which involve existentially quantifying over possible values of \(c\), and which therefore do not preclude context-sensitivity as on the degreeful analysis:

\[ ([\text{Sarah is taller than Mary}]) : \exists c[\text{tall}(\text{Sarah}) \text{ in } c & \neg \text{tall}(\text{Mary}) \text{ in } c] \]

The relevance of this difference for the crisp judgments test is tied to the so-called similarity constraint on vague predicates and its relation to the Sorites Paradox (Klein, 1980; Fara, 2000; Kennedy, 2011), as described in (30):

**Similarity Constraint**

When \(x\) and \(y\) differ only to a very small degree in the property that a vague predicate \(G\) is used to express, speakers are unable or unwilling to judge the proposition that \(x\) is \(G\) true and \(y\) is \(G\) false. (apud Bochnak, 2015: 12)

Because comparatives on the degree-based account do not involve vagueness, they should not be subject to the similarity constraint; on the vagueness-based account the similarity constraint should hold even in comparatives. The prediction for this diagnostic is then that only degreeful comparatives support crisp judgments, i.e., comparatives that target a small difference. If the predicates within the comparative are vague (as on the vague predicate analysis), then speakers should be unwilling to accept the comparative as felicitous.

This prediction is borne out in English:

(31)  **Context:** Essay A is 600 words; Essay B is 597 words.
    a. Essay A is longer than Essay B. \hspace{1cm} \textit{Explicit}
    b. #Compared to Essay A, Essay B is long. \hspace{1cm} \textit{Implicit}

It is also borne out in Fijian, as shown with the contexts in (32) and (33).

(32)  **Context:** Peter is 2cm taller than Mary
    e lekaleka o Meri [ mai-vei Pita ].
    3.SG short PN Mary FROM-PN Peter
    ‘Mary is shorter than Peter.’ (Pearson, 2009: 361)
As with differential comparatives and absolute standard adjectives, the upshot is that Fijian patterns with degreeful languages with respect to crisp judgments. In order to explain these data against the backdrop of a degreeless analysis of Fijian, Pearson (2009) argues that the purpose of the standard marker *mai* is to reduce the context set to the two compared objects (see also Bowler, 2016; Deal and Hohaus, 2019), which explains why vagueness is tolerated in comparatives.

First however, it is unclear why a reduction of individuals in the context should alleviate the Similarity Constraint, as both predicates under question are still vague and very close in measurement. Further, if this were the right analysis, then there would be nothing to distinguish comparatives in a language like Fijian, which do support crisp judgment contexts, from implicit comparatives in a language like English (or Washo, Bochnak, 2015), which do not. I therefore reject this proposal and argue that we can best understand the Fijian data if we adopt a degreeful account of comparatives in the language.

4.1.3. Absolute standard adjectives

The final test I discuss in this paper comes from absolute standard adjectives. Importantly here, the observation is that not all gradable adjectives have context-dependent standards in the positive form (Rotstein and Winter, 2004; Kennedy and McNally, 2005; Kennedy, 2007). Certain adjectives have instead a minimum value as their standard of comparison, e.g. (*wet, open, bent*):

\[(34) \quad x \text{ is bent is true as long as } x \text{ has a non-zero degree of bend.}\]

The standard of evaluation for the positive form of such adjectives is fixed to the minimum endpoint on a scale, regardless of the context. This lack of context-sensitivity is incompatible with the vague predicate analysis of comparatives, as such an analysis makes no reference to scales, only context. On the degreeful analysis of comparatives on the other hand, the predicate is not vague and is therefore not context-sensitive.

The prediction here is then that only degreeful comparatives are compatible with minimum standard predicates, as they require no reference to the context. Again, Kennedy points out that this prediction is borne out in English.

\[(35) \quad a. \quad \text{Context (Kennedy 2007: 20):} \]

\[\text{Rod A: } \quad \text{Rod B: } \]
\[\text{b. Rod B is more bent than Rod A.} \quad \text{Explicit}\]
\[\text{c. ??Compared to Rod A, Rod B is bent.} \quad \text{Implicit}\]

For this particular test, the results from Fijian are mixed. Absolute adjectives are perfectly felicitous in comparatives for my consultant, as shown in (36).
Explicit comparison in Fijian

(36) e takelo vaka levu na vaivo oqo [ mai na vaivo oya ].
    3.SG bent EMPH big ART pipe this from ART pipe that
    ‘This pipe is (much) more bent than that pipe.’

However, similar examples are infelicitous for Pearson’s speaker(s) (2009):

(37) #e takelo na vaivo oqo [ mai na vaivo oya ].
    3.SG bent ART pipe this from ART pipe that
    Intended: ‘This pipe is more bent than that pipe.’ (Pearson, 2009: 361)

The result here is that minimum standard predicates are felicitous in Fijian comparatives – at least for some speakers – a result that is not predicted on the vague predicate analysis, but which is predicted by a degree analysis (I return to the issue of conflicting judgments in Section 4.4). The upshot however is that the data from absolute standard adjectives lend further evidence for a degreeful analysis of Fijian.

4.2. The Degree Semantics Parameter

Moving beyond Kennedy’s tests, diagnostics for degreefulness go beyond the domain of comparatives. The Degree Semantics Parameter (Beck et al., 2009) is based on the idea that languages may either have or lack degrees altogether, across all constructions:

(38) **Degree Semantics Parameter**
    A language \{does, does not\} have gradable predicates (type \langle d, \langle e, t \rangle \rangle and related), i.e. lexical items that introduce degree arguments. (Beck et al., 2009: 19)

The major result of this work is the proposal that certain constructions require degree variables in their meanings, and that if these constructions are found in a language, the language must make use of degrees in its ontology (Beck et al. 2009: 18). Languages with constructions such as those in (39) and (40) are [+DSP], while languages lacking these constructions on the other hand lack degree variables and should be classified as [-DSP].

(39) **Expressions that plausibly manipulate degree arguments:**
    Comparative, superlative, and equative morphemes.

(40) **Expressions that plausibly refer to degrees and combine with degree operators:**
    Degree questions (how tall), comparison with a degree (taller than three feet).

Importantly, while Pearson (2009) does not engage with Beck et al.’s (2009) diagnostics that extend beyond comparatives, Fijian does exhibit a number of these constructions. For example, in relation to the class of expressions described in (40), Fijian has degree questions, which involve quantification over a degree variable by a wh-operator (Rullmann, 1995) (41), as well as comparison to a degree, in which the standard itself refers to a degree (42).

(41) **Degree question**
    E vakacava na balavu ni yalewa?
    3.SG how ART height GEN woman
    ‘How tall is the woman?’
Comparison to a degree

\[ \text{Nai vola e balavu [ mai va-na } \text{ tolu ga na drauniveva ].} \]
\[ \text{ART.GEN book 3.SG long from DIR-ART three only ART page} \]

‘The book is longer than just three pages.’

The conclusion here is that even outside of comparatives, Fijian passes a number of tests for degreefulness. These data should therefore be taken into consideration as well when evaluating the status of Fijian as a \([-/\text{DSP}]\) language.

4.3. Upshot

The aim of the previous section has been to show that Fijian is neither a solely implicit comparison language, nor a \([-\text{DSP}]\) language. First, Fijian passes Kennedy’s (2007) tests for degreeful comparison, with results that should not be treated as exceptions warranting alternative explanations. Second, Fijian passes Beck et al.’s (2009) diagnostics for degreefulness beyond the domain of comparatives. Following Occam’s razor, a revised semantics is not needed to explain why Fijian behaves this way: The language makes use of degrees.

4.4. A note on diachrony

Before moving on to an analysis of explicit comparatives in Fijian, a note on diachrony is in order. It has been demonstrated that Samoan, another Oceanic language, historically made use of implicit comparatives, but now only uses the explicit strategy (Hohaus, 2018). Fijian may well be on this path, considering that the implicit construction is no longer used by all speakers, with the explicit construction being the dominant one.

We also find a similarity in the comparative morpheme across the two languages: Like Fijian \textit{cake}, the \textit{-er/more} morpheme \textit{atu} in Samoan is a directional element, suggesting a similar path to grammaticalization (see Hohaus for an analysis of this path).

\[ \text{e umi } \text{atu Temukisa i [ lõ Malia ]}. \]
\[ \text{3.SG tall DIR Temukisa PREP COMP Mary} \]

‘Temukisa is taller than Mary.’ (Hohaus, 2018: 110)

The variation in judgments for different speakers of Fijian potentially indicates a changing system in the language. The presence of both constructions in a single language raises exciting questions about the treatment of comparatives (see also Davis and Mellesmoen (2019) for related work on co-existing systems in Salish), but this is beyond the scope of the present paper.

5. Toward a direct analysis

In the final section of this paper, I aim to give a preliminary analysis of the explicit comparative in Fijian. To do this, I offer a \textit{direct} analysis (see also Pancheva, 2006; Merchant, 2009; Bhatt and Takahashi, 2011; Shimoyama, 2011; Bochnak, 2018), as I show the standard of comparison in Fijian comparatives to be exclusively phrasal.\(^\text{12}\) I propose an analysis for separative

\(^{12}\text{For more on the phrasal vs. clausal distinction in comparatives, see Hankamer (1973); Merchant (2009); Potsdam (2011); Bhatt and Takahashi (2011).} \]
comparatives in Fijian that builds on Potsdam’s (2011) syntactic analysis of separative comparatives in Malagasy, and Heim’s (1985) semantics for direct comparison. The proposal in a nutshell is that the standard in separative comparatives is individual-denoting, and that there is a (potentially silent) comparative head MORE in the construction.

5.1. Phrasal vs. clausal standards

Explicit comparatives across languages have been shown to make use of both phrasal (44a) and clausal (44b) comparatives.

(44)  a. Sarah is taller than [ Mary ].\hspace{1cm}\textit{phrasal}
    b. Sarah is taller than [ Mary is ].\hspace{1cm}\textit{clausal}

One approach to comparatives assimilates both standard types to an underlyingly clausal source, where the difference in pronounced material is the product of different kinds of ellipsis (i.a. Chomsky 1965, 1977; Bresnan, 1973; von Stechow, 1984; Lechner, 2001, 2004):

(45)  a. Sarah is taller [ than Mary is \textit{d-tall} ].\hspace{1cm}\textit{stripping}
    b. Sarah is taller [ than Mary is \textit{d-tall} ].\hspace{1cm}\textit{comparative deletion}

On this line of analysis, the comparative degree head MORE always takes two arguments, both of which are properties of degrees (\langle d, t \rangle), the first being supplied by the clausal standard:\footnote{Operator movement results in degree abstraction; see Chomsky (1977).}

(46) \begin{align*}
\text{2-place MORE} &\hspace{1cm} [[\text{MORE}]]: \lambda P_{(d,t)} \lambda Q_{(d,t)} [\text{MAX}(Q) > \text{MAX}(P)] \hspace{1cm}\text{repeated from (13)}
\end{align*}

An alternative to this unified approach is the idea that phrasal comparatives are not derived from a clausal source, i.e., the standard has not undergone any ellipsis (Heim, 1985; Bhatt and Takahashi, 2011; Potsdam, 2011; Shimoyama, 2011).\footnote{See Bhatt and Takahashi (2011) for more on ‘2-place’ and ‘3-place’ meanings for MORE.} In this case, MORE takes as its first argument an individual – rather than a degree – which is supplied by an individual-denoting PP standard (e.g., \textit{than Mary}) (47). This type of analysis therefore takes phrasal comparatives at face value: There is no ellipsis producing the phrasal standard from a larger structure, and MORE is potentially ambiguous between a 2-place and 3-place meaning.

(47) \begin{align*}
\text{3-place MORE} &\hspace{1cm} [[\text{MORE}_3]]: \lambda x_e \lambda G_{(d,\langle e,t \rangle)} \lambda y_e [\text{MAX}(\lambda d.G(y) \geq d) > \text{MAX}(\lambda d'.G(x) \geq d')] 
\end{align*}

I will adopt this latter type of direct analysis for Fijian, which I turn to in the next subsection.

5.2. A direct analysis for Fijian

In a nutshell, the analysis I propose for Fijian is as follows. In an example such as (48a), the standard marker \\textit{mai} ‘from’ selects for a DP argument. As PPs are individual denoting and therefore of type e, [[MORE$_3$]] then takes this entire individual as its first argument before composing with the adjective (48b). The derivation below adopts the classical analysis of degree structure from Bresnan (1973), though the comparative morpheme here follows the adjective to reflect word order.
The meaning of the entire comparative as in (48a) is then that in (49), after the subject is added:

\[
\operatorname{MAX}(\lambda d.\text{heavy}(x) \geq d) > \operatorname{MAX}(\lambda d'.\text{heavy}(\text{that rock}) \geq d')
\]

In the next subsection, I motivate this analysis with data supporting a phrasal analysis.

5.3. Fijian lacks clausal standards

The first piece of evidence for a direct analysis of comparatives in Fijian is that clausal standards are never allowed in the language. For instance, as (50) shows, clausal standards are ungrammatical (with or without comparative deletion of the embedded adjective, cf. (10)):

\[
* e \text{ katakata cake }'o \text{ Viti [ mai-vei e (katakata) }'o \text{ Peritaania ].}
\]

\[
\text{Intended: 'Fiji is hotter than Britain is (hot).'}
\]

Evidence that phrasal standards are not the result of obligatory ellipsis (e.g., stripping) comes from the unavailability of subcomparatives. As Potsdam (2011) notes in his work on comparatives in Malagasy, this is a construction where ellipsis would not be allowed and where we might expect to find clausal standards if the language allowed them in restricted contexts. This is because subcomparatives require a contrast at least in gradable predicates across clauses, which would violate the identity requirement on ellipsis:

\[
\exists d_1[d_1 > t d_2[\text{the door is }d_2-\text{tall]} \& \text{[the window is }d_1-\text{wide}]] \quad \text{(Heim, 1985)}
\]

\[\text{An example of a nominal comparative is shown below:}
\]

\[
\text{(i) e a voltaia-levu ko Meri na appolo [ mai va-na moli ],}
\]

\[
\text{3.SG PST buy EMPH-big PN Mary ART apple from DIR-ART banana}
\]

\[
\text{‘Mary bought more apples than bananas.’}
\]

It is worth noting that nominal and adverbial comparatives make use of a different standard marker, \textit{levu} ‘big’.
Just as in Malagasy, clausal subcomparatives in Fijian are ungrammatical, and require a nominal standard instead, consistent with a ban on clausal standards:

(52) Na katubaleka e raraba [ mai-va [ dp na balvu ni katuba ]].

   ART window 3.SG wide from-DIR the height of the door

‘The window is wider than the height of the door.’

It is worthwhile to note here that Bochnak (2018) argues for Luganda that these require a 2-place analysis due to the need for a degree argument inside a nominal standard such as the height of the door. Further, Bhatt and Takahashi (2011) likewise argue that a 2-place analysis is required for comparison with a degree, which Fijian does make use of as shown in e.g., (22) (though note that this still does not necessitate ellipsis in the standard). Bhatt and Takahashi argue that 2-place MORE is in fact more basic than its 3-place counterpart, suggesting that an ambiguity in the meaning of more is unsurprising in Fijian, and is a semantic fact. The ban on clausal standards, on the other hand, is a syntactic one, which I turn to immediately.

This ban on clausal standards in Fijian is ultimately not surprisingly, given independent syntactic facts about the language. In particular, the lack of clausal comparatives in Fijian is in line with Bhatt and Takahashi’s (2011) observation about Hindi that clausal standards are disallowed when the standard marker is not able to embed a finite clause on its own. In Fijian, the standard marker mai is the preposition ‘from’.\(^{16}\)

(53) mai na koro
from ART village

‘from the village’ (Milner, 1967: 58)

Mai can also have the meaning of ‘since’ when used alongside the noun gauna ‘time’, but, unlike English, is nevertheless unable to embed a clause on its own.\(^{17}\)

(54) Au a marau mai *(va-na gauna) [ iko a lako mai kina ].
1.SG PST happy from DIR-ART time that PST arrive from you

‘I’ve been happy since you arrived.’

Comparatives in Fijian are therefore generally limited to individual-denoting, DP standards, which is the result of the selectional requirements on the prepositional standard marker mai.

In sum, the data above converge to reveal that Fijian lacks clausal standards for independent syntactic reasons, rendering the direct and phrasal account the best analysis for the language (outside of comparison to a degree).

\(^{16}\)Mai also occurs as a post-verbal particle, the behavior of which is described in some detail in van Urk (2019). In its prepositional form, mai often co-occurs with another directional particle, va/vei, meaning something like ‘to/towards’.

\(^{17}\)Note that the prepositional status of this marker rules out the presence of a standard containing its own preposition, such as the construction in (i), as P may not select for P:

(i) *’o Meri ea danisi vaka levu kei ira na tagane mai-vei [ pp kei ira ne yalewa ].
   PN Mary 3.PRO dance INTNS big with 3.PRO ART men from-DIR with 3.PRO ART women
   Intended: ‘Mary danced more with men than with women.’

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6. Conclusion

In sum, Fijian has explicit, degreeful comparatives, and should not be analyzed as a degreeless language. I have argued for this conclusion based not only on morphological diagnostics for implicit vs. explicit comparison, but also on tests for degreefulness both in the domain of comparatives (Kennedy, 2007) and beyond (Beck et al., 2009), which Fijian passes.

Further, I have shown that understanding Fijian as an explicit comparison language reveals a language with unreduced phrasal standards. The language displays similar behaviors to other languages with prepositional standard markers, such as Hindi and Malagasy. The preliminary analysis presented here for a direct approach to Fijian comparatives captures this similarity.

Larger questions that emerge from this work have to do with i) potential diachronic change in Fijian and ii) the relationship between degree morphology and degrees in the ontology. The data here reflect judgments of a single speaker, and are sometimes at odds with the data presented in Pearson (2009). As discussed in Section 4.4, the loss of an implicit comparison is attested elsewhere in Austronesian; while this loss is suggested to be underway in Fijian, the potential for a mixed comparative system raises interesting questions. On the second point, I have dedicated some discussion to the assumed (but potentially erroneous) correlation between degreefulness and degree morphology. While this correlation appears to be upheld in Fijian, the relationship between meaning and form in comparatives remains an empirical question.

References


Explicit comparison in Fijian


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A neurolinguistic investigation into semantic differences of evidentiality and modality

Yurie HARA — Hokkaido University
Naho ORITA — Waseda University
Deng YING — The University of Tokyo
Takeshi KOSHIZUKA — Tokyo University of Science
Hiromu SAKAI — Waseda University

Abstract. Corpus and EEG studies were conducted to reveal behavioral and neurological differences between processing of Japanese modals and evidentials.

Keywords: evidentiality, modality, causality, electroencephalography, Japanese.

1. Introduction

Many of the prominent studies on inferential evidentials (Izvorski, 1997; Matthewson et al., 2006; McCready and Ogata, 2007) have argued that evidentiality is a kind of modality. Davis and Hara (2014) and Hara (2017) (henceforth, D&H) argue against this evidential-as-modal approach and make two claims: 1. The Japanese sentence-final auxiliary ｙooda ‘it seems’ as in (1) is a morpheme of evidentiality which is distinct from canonical modal auxiliaries like ｄaroo ‘I bet/probably’ in (2). 2. The semantics of ｙooda relies on the notion of causality.

(1) Ame-ga futta yooda.
    rain-NOM fell  EVID
    ‘It seems that it rained.’

(2) Michi-ga nureteiru daroo.
    streets-NOM wet  I-bet
    ‘The streets are wet, I bet/probably.’

The goal of this paper is to justify D&H’s theoretical claims by way of corpus and EEG experiment. This paper is structured as follows: Section 2 reviews D&H’s argument and Hara’s (2017) formal analysis. In particular, ｙooda and ｄaroo belong to distinct categories and the semantics of ｙooda presupposes a causal relation and asserts that the speaker perceives the effect state of the causal relation. Crucially, the assertional content of ｙooda does not involve semantics of modality, i.e., quantification over possible worlds. In contrast, ｄaroo is an epistemic necessity modal and does not have a causality presupposition. Section 3 presents the research questions of the study. The current study investigates whether the corpus and EEG experiment support the idea that evidentialy and modality are separate categories. Section 4 discusses the result of the corpus study, which confirms the native speaker’s intuition that ｐ in ｐ-ｙooda expresses a cause event. ｙooda tends to follow cause-denoting predicates, while ｄaroo tends to follow state-denoting predicates. The corpus result alone does not reveal the

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1 This project is supported by NINIAL Project “Cognitive Neuroscience of Linguistic Variation in Pragmatic Inference” (PI: Hiromu Sakai), JSPS Kiban (C) “Semantic-Pragmatic Interfaces at Left Periphery: a neuroscientific approach” (18K00589; PI: Yurie Hara), and JSPS Kiban (A) “How does the grammar emerge in the human brain: A view from comparative cognitive neurosciences of East Asian languages” (15H01881; PI: Hiromu Sakai). We are grateful to Aine Ito, Yohei Ozeki, and Masa Yano for their help with analysis and to Tsu-Yin Chen and Saaya Mori for their assistance in data collection.

The difference between *yooda* and *daroo* with respect to whether or not the causality requirement is semantically encoded. Section 5 presents our EEG experiment that overcomes this shortcoming of the corpus study. The felicitous *yooda* condition elicits LAN which is an index of a successful causal inference (Baggio et al., 2008; Cohn and Kutas, 2015) (alternatively, the infelicitous condition elicits N400/P600 effect). In contrast, there is no significant difference in the waveforms between the felicitous and infelicitous *daroo* conditions. This suggests that *yooda* encodes the causality requirement in its semantics while *daroo* sentences give rise to a causal inference in pragmatics. Furthermore, the processing of *daroo* elicits N400, which is argued to be an index of an increase of cost in the processing of possible worlds (Dwivedi et al., 2006; Kulakova et al., 2014; Kulakova and Nieuwland, 2016). Section 6 concludes the paper.

2. Modality and Evidentiality

Evidentials are morphemes that signal the source of information a speaker has to make the claim (Aikhenvald, 2004; Willett, 1988). Evidential morphemes are distinguished depending on their evidence types. For instance, Willett (1988) provides the following typology of evidence types.

![Figure 1: Willett’s (1988: 57) typology of evidence types](image)

Japanese has a rich paradigm of indirect evidential markers such as *yooda/mitaida/rasii* ‘it seems/appears’, *TP+sooda* ‘I hear’, and *V+sooda* ‘looks like’ (Aoki, 1986; McCready and Ogata, 2007; Hara, to appear). To our knowledge, the work by McCready and Ogata (2007) is the first to give a formal analysis to the Japanese indirect evidentials. According to McCready and Ogata (2007), evidential markers should be treated as a kind of epistemic modal. Many of the leading literature on evidentiality in other languages (Izvorski, 1997; Matthewson et al., 2006) also classifies evidentiality under the general category of epistemic modality. On the other hand, canonical modals like English *must* are argued to belong to the inferential evidentials (von Fintel and Gillies, 2010; Degen et al., 2019) blurring the boundary between evidentiality and modality. By examining the semantics of Japanese inferential evidential *yooda*, D&H show that evidentials constitute a category distinct from epistemic modality.
2.1. Lack of epistemic commitment

D&H show that *yooda* is different from *daroo* in that the prejacent *p* in *p-yooda* is not an at-issue commitment of the sentence since it is cancellable.

In (3) and (4), both a bare assertion *p* and *p-daroo* commit the speaker to *p*, thus *p* cannot be cancelled.

(3) #Ame-ga futta kedo jitsu-wa futtenai.  
   rain-NOM fell but actually fall-NEG  
   ‘It rained but in fact it didn’t.’

(4) #Ame-ga futta daroo kedo jitsu-wa futtenai.  
   rain-NOM fell I-bet but actually fall-NEG  
   ‘Probably, it rained but in fact it didn’t.’

In contrast, the prejacent *p* in *p-yooda* is cancellable as in (5).

(5) Ame-ga futta yooda kedo, jitsu-wa futte-nai. (Dereka-ga mizu-o maitanda.)  
   rain-NOM fell EVID but actually fall-NEG someone-NOM water-ACC sprayed  
   ‘It seems that it rained, but in fact it didn’t. (Someone sprayed water.)’

In short, if *p-yooda* were a kind of modality, it should also give rise to a (weak) commitment to *p*. Since its prejacent is cancellable, *yooda* belongs to a different category.

2.2. Causality

D&H also claim that the notion of evidentiality needs to encode asymmetric causal dependencies: Rain causes wet streets but not vice versa. McCready and Ogata (2007) propose a Bayesian modal semantics for a number of evidentials. In M&O’s analysis, what counts as evidence in asserting *p-yooda* is some information *q* such that learning *q* raised *a*’s subjective probability of *p*. In (6), thus, *a* learns that the streets are wet, which has led *a* to raise her subjective probability of *p*, hence the use of *yooda* is acceptable.

(6) (Looking at wet streets)  
   Ame-ga futta yooda.  
   rain-NOM fell EVID  
   ‘It seems that it rained.’

However, D&H show that it makes wrong predictions if we switch *p* and *q*, as in (7). Learning that it is raining should also raise the agent’s subjective probability of “the streets are wet”, thus M&O wrongly predict that *yooda* would be acceptable in (7).

(7) (Looking at falling raindrops)  
   #Michi-ga nureteiru yooda.  
   streets-NOM wet EVID  
   ‘It seems that the streets are wet.’

From this observation, D&H propose that what counts as evidence in asserting *p-yooda* is some information *q* such that *p* causes *q*. 

A neurolinguistic investigation into semantic differences of evidentiality and modality
Daroo seems to be in a complementary distribution with yooda. That is, \( p\)-daroo is infelicitous when the speaker learns information \( q \) such that \( p \) causes \( q \) as in (8), while it is felicitous when the information \( q \) is such that \( q \) causes \( p \) as in (9).

(8) (Looking at wet streets)

\[ \#\text{Ame-ga futta daroo.} \]

\[ \text{#Probably, it rained.} \]

(9) (Looking at falling raindrops)

\[ \text{Michi-ga nureteiru daroo.} \]

\[ \text{Probably, the streets are wet.} \]

We assume with Hara and Davis (2013) that unlike the case of yooda, the causality is not lexically encoded in the semantics of daroo. Rather, the above contrast is a result of pragmatic competition. Yooda has a stronger semantics since it requires a more specific context than yooda. Since yooda is a better candidate for the context in (8), daroo is infelicitous in (8). See Hara and Davis (2013) for details.

To conclude, the semantics of \( p\)-yooda is dependent on causality. More specifically, \( p \) in \( p\)-yooda denotes a cause event in a causal relation, \( p \) causes \( q \). In contrast, the seeming causal requirement on the use of daroo arises as a result of pragmatic competition.

2.3. Semantics of daroo and yooda

Given D&H’s observation, Hara (2017) formulates the semantics of yooda in Kaufmann’s (2013) Causal Premise Semantics, which incorporates causal networks to Kratzer’s (2005) premise semantics. Let \( f \) and \( g \) be premise background and ordering source respectively and \( w \) a possible world. Premise structure \( \text{Prem}(\text{((}f \ast g\text{)}(w))) \) is obtained by ranking Kratzer premise sets.\(^2\) Basic modal operators, Must and May, are defined as follows:

(10) a. Must\((p)\) is true at \( f, g, w \) iff \( p \) is a necessity relative to \( \text{Prem}(\text{((}f \ast g\text{)}(w))) \).

b. May\((p)\) is true at \( f, g, w \) iff \( p \) is a possibility relative to \( \text{Prem}(\text{((}f \ast g\text{)}(w))) \).

We propose that daroo is a necessity modal, with the following interpretation:\(^3\)

(11) **Interpretation of daroo:** Daroo\((p)\) is true at \( f, g, w \) iff Must\((p)\) is true at \( f, g, w \).

Turning to the evidential yooda, Hara’s (2017) formalization of causality is built on the interpretation of conditionals. In the current framework, we obtain a causal premise background \( f, [p] \) by hypothetically updating a causal premise background \( f, \) with the antecedent proposition \( p \) as in (12).

(12) **Hypothetical update:** For all \( w \): \( f[p](w) := \{ \{ p \} \} \ast f(w) \).

Thus, ‘\( p \) causes \( q \)’ is formulated as Must\(_p\)(\( q \)) in (13):

\(^2\)Many of the definitions are omitted for space reasons. See Hara (2017) and Kaufmann (2013).

\(^3\)Daroo has some other interesting lexical restrictions which are irrelevant to the current purpose of the study. See Hara (2006, 2018).
Causal rule: Must$_p(q)$ is true at $\mathbf{f}_c, \mathbf{g}, w$ iff Must$_p(q)$ is true at $\mathbf{f}_c[p], \mathbf{g}, w$.

Finally, we define the interpretation of *yooda*. As shown by D&H, asserting *p-yooda* does not commit the speaker to *p*, thus *p* contributes to the antecedent part of the conditional rather than the consequent, i.e., Must$_p(q)$. In Hara’s (2017) original definition, the causal component Must$_p(q)$ was part of the asserted content. Here, we differ from Hara’s (2017) original analysis and place the causal component in the presupposition since it is part of the common ground and it is not asserted (e.g., in uttering (1), the speaker is not asserting ‘rain causes wet streets’ but assuming that it is commonly known.). Thus, the interpretation of *yooda* is defined as in (14): *Yooda*(p) presupposes that there is some state $q$ such that $q$ is a necessity relative to Prem($((\mathbf{f}_c[p]^*\mathbf{g})(w))$) and asserts that the speaker perceives $q$ at $w$.

(14) **Interpretation of *yooda*:**

Yooda($p$) is defined at $\mathbf{f}_c, \mathbf{g}, w$ iff $\exists q$ such that Must$_p(q)$ is true at $\mathbf{f}_c, \mathbf{g}, w$.

If defined, Yooda($p$) is true at $w$ iff the speaker perceives $q$ at $w$.

As can be seen in (14), the assertion of *p-yooda* is evaluated only at the single actual/utterance world $w$. As with D&H, our definition (14) correctly derives the interpretations and distributions of *yooda* discussed above. In (5), the speaker presupposes that raining causes wet streets and she only asserts that she observed wet streets, which are usually caused by raining but could be caused by other factors, e.g., someone sprayed water with a hose. (7) causes a presupposition failure since we know, as background knowledge, that wet streets do not cause rain.

In summary, *yooda* belongs to the category of evidentiality which is distinguished from that of modality such as *daroo*. The semantics of *p-yooda* includes a presupposition that there is an event $q$ such that $p$ causes $q$. The assertion of *p-yooda* does not commit the speaker to *p* but only entails that the speaker perceives $q$. In contrast, *p-daroo* is an epistemic necessity modal, the semantics of which involves quantification over possible worlds, thus the assertion of it commits the speaker to *p*. Furthermore, *daroo* does not have a causality presupposition like *yooda*. As discussed in Section 2.2, the apparent causal restriction that $p$ in *p-daroo* needs to denote an effect state is a result of pragmatic competition.

### 3. Research Questions

The previous section summarized D&H’s claims that evidentials and modals are separate categories and that the interpretation of *yooda* is dependent on causality. The goal of this paper is to empirically justify these claims using corpus and an EEG experiment:

(15) **Research Question 1**

Can we justify the theoretical claims by way of corpus/EEG studies?

(16) **Research Question 2**

Are there neural indices that indicate the computational difference between modals and evidentials?
Table 1: NPMI

<table>
<thead>
<tr>
<th></th>
<th>yoooda</th>
<th>daroo</th>
</tr>
</thead>
<tbody>
<tr>
<td>past</td>
<td>0.22</td>
<td>&gt; 0.057</td>
</tr>
<tr>
<td>non-past</td>
<td>0.177</td>
<td>&lt; 0.214</td>
</tr>
<tr>
<td>verb</td>
<td>0.204</td>
<td>&gt; 0.188</td>
</tr>
<tr>
<td>verb-positive</td>
<td>0.196</td>
<td>&gt; 0.17</td>
</tr>
<tr>
<td>verb-negative</td>
<td>0.209</td>
<td>&lt; 0.253</td>
</tr>
<tr>
<td>adjective</td>
<td>0.116</td>
<td>&lt; 0.135</td>
</tr>
</tbody>
</table>

4. Corpus

We conducted a corpus study to test whether the distribution of *yoooda* is dependent on the causal relation. Since the corpus does not contain information on whether a predicate denotes a cause or effect, we made the assumptions in (17) and the predictions in (18):

(17) a. Causes are events while effects are states.
    b. The cause event temporally precedes the effect state.

(18) a. *Yoooda* tends to be attached to past-tensed and eventive predicates.
    b. *Daroo* tends to be attached to non-past and stative predicates.

To test the predictions in (18), we use Balanced Corpus of Contemporary Written Japanese (BCCWJ) (Maekawa et al., 2014) containing approximately 100 million words collected from various kinds of Japanese texts. We extract sentences ending with *daroo* and *yoooda*, resulting in 30,686 *yoooda* sentences and 47,538 *daroo* sentences. We measured Normalized Pointwise Mutual Information (NPMI): The higher positive values of NPMI indicate stronger associations or positive correlations between kinds of predicates and final auxiliaries *yoooda/daroo*. Table 1 summarizes the result. As predicted, *yoooda* has better associations with past-tensed predicates and positive verbs, which tend to denote events, while *daroo* has better associations with non-past predicates and negative verbs and adjectives, which tend to denote states (Krifka, 1990).

In short, *yoooda* is more likely to follow past-tensed predicates and positive verbs, which are likely to denote cause events, than non-past predicates and negative verbs and adjectives, which are likely to denote effect states. This result is in accordance with D&H’s claim that causality is crucial in the interpretation of *yoooda*: *p* in *p-yoooda* denotes a cause event in a causal relation. The current result also shows that *daroo* is more likely to follow non-past predicates, negative verbs and adjectives, which are likely to denote effect states. As discussed in Sections 2.2 and 2.3, the lexical semantics of *daroo* does not involve causality requirement. Thus, we interpret this result as an outcome of the pragmatic competition between *yoooda* and *daroo*.

5. EEG

An EEG experiment was conducted to address the research questions laid out above in Section 3.

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4 NPMI is represented by a value between $[-1, +1]$. If two predicates have zero co-occurrence, NPMI is $-1$. If they are independent, it is 0. If they always co-occur, it is $+1$. See Bouma (2009).
5.1. Participants

Thirty-eight right-handed native Japanese speakers were paid to participate in this study. Six participants were excluded from the analysis because of facility disorder. After artifact rejection, two more participants were excluded from the analysis due to the extremely small number of valid trials in their data (less than 15 trials in at least one of the conditions). The final analysis was conducted with 30 participants (16 males, mean age 20.9 years, age range 18 to 24 years). All participants were right-handed and reported normal vision without any history of neurological or psychiatric disorders. Written consent was obtained from all participants.

5.2. Stimuli

The stimuli had two fully-crossed factors—CONTEXT (Effect-Cause/Cause-Effect) and SFA (sentence-final-auxiliary; *yooda/daroo*)—which resulted in four conditions:

(19) a. ECy: Effect-Cause-*yooda*:
   Michi-ga nureteiru. Ame-ga futta yooda.
   streets-NOM wet rain-NOM fell EVID
   ‘The streets are wet. It seems that it rained.’

b. CEy: Cause-Effect-*yooda*:
   #Ame-ga futta. Michi-ga nureteiru yooda.
   rain-NOM fell streets-NOM wet EVID
   ‘It rained. It seems that the streets are wet.’

c. CEd: Cause-Effect-*daroo*:
   Ame-ga futta. Michi-ga nureteiru daroo.
   rain-NOM fell streets-NOM wet I-bet
   ‘It rained. The streets are wet, probably.’

d. ECd: Effect-Cause-*daroo*:
   #Michi-ga nureteiru. Ame-ga futta daroo.
   streets-NOM wet rain-NOM fell I-bet
   ‘The streets are wet. It rained, probably’

ECy is a fit condition where the final auxiliary *yooda*, which semantically presupposes that there is a causal relation and attaches to a proposition that denotes the cause event, matches the Effect-Cause context. CEy is an anomalous condition where *yooda* is attached to the effect state in a causal relation. CEd is a fit condition where the final auxiliary *daroo* is attached to a conclusion drawn from premises. ECd is an anomalous condition, but unlike CEy, which is semantically anomalous, it is pragmatically anomalous. That is, as argued in Section 2, unlike *yooda, daroo* does not lexically encode a causal relation in its semantics. (19d) is anomalous because *yooda*, which semantically encodes the causal requirement, is more optimal in the Effect-Cause context.

All the stimuli were normed for naturalness by Japanese native speakers.

5.3. Procedure

Each condition had 78 items. 78 fillers were included. The experiment was counterbalanced so that one participant will not see the same context twice (234 trials in each experiment). The
procedure of a trial is depicted in Figure 2. Each trial started with a fixation cross shown for 600ms. After 300ms blank screen, each word of the first sentence was presented for 600ms with an inter-word interval of 300ms. After the first sentence was presented, a ‘˜’ sign is presented for 600ms to let the participants to blink. After 300ms blank screen, the second sentence was presented. At the end of each filler trial, subjects were asked to give a yes/no response to an acceptability judgement task.

![Figure 2: Procedure of a trial](image)

**Figure 2: Procedure of a trial**

5.4. Recording

EEG was recorded using AC amplifiers (Brain Products) from 32 electrodes equipped in an elastic cap (EASYCAP) according to the International 1020 system. Electrodes included the following positions: FP1, FP2, F7, F3, Fz, F4, F8, FC5, FC1, FC2, FC6, T7, C3, C1, Cz, C4, T8, CP5, CP1, CP2, CP6, TP9, P3, Pz, P4, P8, TP10, O1, and O2. Another electrode was placed at nose for online referencing. Offline, all electrode sites were re-referenced to the average of the right and left mastoids. The electro-oculogram (EOG) was located at the outer canthus of right eye in order to detect horizontal eye movements and blinks. Scalp impedances were kept below 5 kΩ. The continuous EEG was digitized at 250 Hz and filtered offline (high-pass at 0.5 Hz and low-pass at 40 Hz).

5.5. Analysis

ERPs were calculated by averaging the EEG time-locked to a point 200ms pre-stimulus onset and lasting until 1000ms after the onset of the stimulus. The 200ms pre-stimulus period was used as a baseline. Trials containing ocular or muscular artifacts, were not taken into consideration in the averaging process. Based on visual inspection of ERP waveforms and the time windows of potential effects, two time windows were selected for statistical analyses: 300-
500ms and 500-700ms. Repeated-measures ANOVA (\textit{anovakun} 4.8.3\textsuperscript{5} implemented in R (R Core Team, 2019)) were performed with the factors CONTEXT (Cause-Effect/Effect-Cause), SFA (sentence-final auxiliary; \textit{yooda/daroo}) and ROI (regions of interests). Six ROIs are obtained by calculating the mean of the three electrodes in each region (anterior-left (AL; F3, F7, FC5); anterior-right (AR; F4, F8, FC6); central-left (CL; FC1, CP1, CP5); central-right (CR; FC2, CP2, CP6); posterior-left (PL; P3, P7, O1); posterior-right (PR; P4, P8, O2)) as in Figure 3.

![Figure 3: 6ROI (Taken from Kulakova et al. (2014))](http://riseki.php.xdomain.jp/)

5.6. Result

A $2 \times 2 \times 6$ repeated measures ANOVA with the factors CONTEXT (CE/EC), SFA (y/d) and ROI in the 500-700ms time window revealed a three-way interaction ($F(5, 145) = 3.19, p < .01$; Figure 4). The EC\textit{y} condition elicited a significantly more negative-deflection at AL compared to CE\textit{y} ($F(1, 29) = 8.06, p < .01$). At PR, the CE\textit{y} condition elicited a significantly more negative-deflection at ($F(1, 29) = 7.03, p < .05$) compared to EC\textit{y}. In EC conditions, \textit{yooda} was significantly more negative compared to \textit{daroo} in AL ($F(1, 29) = 18.63, p < .001$), PL ($F(1, 29) = 5.63, p < .05$) and PR ($F(1, 29) = 17.51, p < .001$). There was no significant difference between EC\textit{d} and CE\textit{d} conditions nor between CE\textit{y} and CE\textit{d}. Detailed test-statistics in the 500-700ms time window are shown in Table 2.

\textsuperscript{5}http://riseki.php.xdomain.jp/
(a) Grand average waveforms time-locked to the final auxiliary

(b) Conditions

(c) ECy–CEy

Figure 4: 3-way interaction
Table 2: Test-statistics of the ERPs in the 500-700ms time window

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>F</th>
<th>p</th>
<th>sig.</th>
</tr>
</thead>
<tbody>
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<td>1.29</td>
<td>3.78</td>
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<tr>
<td>CONTEXT</td>
<td>1.29</td>
<td>0.98</td>
<td>0.32</td>
<td>ns</td>
</tr>
<tr>
<td>ROI</td>
<td>5.145</td>
<td>7.11</td>
<td>&lt; 0.001</td>
<td>***</td>
</tr>
<tr>
<td>SFA × CONTEXT</td>
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<td>0.07</td>
<td>0.786</td>
<td>ns</td>
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<tr>
<td>SFA × ROI</td>
<td>5.145</td>
<td>4.95</td>
<td>&lt; 0.001</td>
<td>***</td>
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<td>CONTEXT × ROI</td>
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<tr>
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<td>3.19</td>
<td>0.009</td>
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<tr>
<td>CONTEXT at AL</td>
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<td>1.29</td>
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<td>7.2692</td>
<td>&lt; 0.001</td>
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<td>&lt; 0.001</td>
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<td>1.13</td>
<td>0.29</td>
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<tr>
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<td>0.70</td>
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<td>0.45</td>
<td>ns</td>
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<td>5.63</td>
<td>0.02</td>
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<td>SFA at PR</td>
<td>1.29</td>
<td>17.51</td>
<td>&lt; 0.001</td>
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A 2 × 6 repeated measures ANOVA with the factors SFA and ROI in the 300-500ms time window revealed that there was a significant SFA × ROI interaction ($F(5, 145) = 7.12, p < .001$; Figure 5). *Daroo* elicited a significantly more positive-deflection at AL ($F(1, 29) = 12.44, p < .01$) and a significantly more negative-deflection at central (CL: $F(1, 29) = 5.30, p < .05$; CR: $F(1, 29) = 12.97, p < .01$) and posterior (PL: $F(1, 29) = 4.85, p < .05$; PR: $F(1, 29) = 12.14, p < .01$) regions compared to *yooda*. There was also a significant CONTEXT × ROI interaction ($F(5, 145) = 3.00, p < .05$). The CE conditions were significantly more negative compared to the EC conditions at PL ($F(1, 29) = 4.44, p < .05$) and PR ($F(1, 29) = 6.05, p < .05$). Detailed test-statistics in the 300-500ms time window are shown in Table 3.
(a) Grand average waveforms time-locked to the final auxiliary

(b) Conditions

(c) daroo − yooda

Figure 5: SFA × ROI interaction
Table 3: Test-statistics of the ERPs in the 300-500ms time window

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<td>***</td>
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<td>1.29</td>
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<td>7.12</td>
<td>&lt; 0.001</td>
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<td>3.00</td>
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<td>1.63</td>
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<tr>
<td><strong>SFA×ROI</strong></td>
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<tr>
<td>SFA at AL</td>
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<td>SFA at AR</td>
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<td>SFA at PL</td>
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<td>CONTEXT at AL</td>
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<td>CONTEXT at PR</td>
<td>1.29</td>
<td>6.05</td>
<td>0.02</td>
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5.7. Discussion

5.7.1. Semantics/Pragmatics of Causality

We interpret the anterior negativity elicited by the EC_y condition (Figure 6) as Left-Anterior Negativity (LAN), which is argued to be a correlate of successful causal inference (Baggio et al., 2008; Cohn and Kutas, 2015).

![Figure 6: LAN (elicited by EC_y) or P600 (elicited by CE_y)](image-url)
An alternative interpretation is to regard an anterior negativity elicited by the ECy condition (Figure 6) as a positivity elicited by the CEy condition. In this interpretation, the negativity observed in Figure 7 and the positivity observed in Figure 6 are N400/P600 pattern caused by semantic anomaly and reanalysis. Frontal P600 may seem unconventional because P600 elicited by grammatically anomalous constructions is usually observed in posterior regions (e.g., Coulson et al., 1998). However, Kaan and Swaab (2003) report that frontal P600 is an index of ambiguity resolution and processing difficulty in discourse. Indeed, Dwivedi et al. (2006) observe left-frontal P600 for anomalous discourse. Furthermore, when the experiment involves an acceptability judgment task, it is reported that semantically anomalous constructions tend to yield N400 followed by P600 (Kuperberg, 2007; Kulakova et al., 2014), although in Kuperberg (2007); Kulakova et al. (2014), P600 is found in central/posterior regions.

![Figure 7: N400 (elicited by CEy)](image)

Between the two interpretations, we find the first more tenable than the latter. If the ECy condition elicits LAN, only ECy is predicted to deflect negative compared to the other three conditions. Similarly, if CEy elicits P600, only CEy is predicted to deflect positive compared to the other three. In the current experiment, there was a significant difference not only between ECy and CEy but also between ECy and ECd. That is, ECy was more negative compared to both CEy and ECd at AL. In contrast, there was no significant difference between CEy and CEd. Thus, we regard the negativity elicited by ECy is LAN, which indexes successful causal inference.

While significant differences between the two yooda conditions were obtained, there was no significant difference between the two daroo conditions, CEd and ECd. We attribute this difference between two auxiliaries to the status of causality in each morpheme. That is, as argued in Section 2, the ECd is only pragmatically anomalous since there is a better auxiliary, namely yooda, which fits the Effect-Cause context. Thus, pragmatic anomaly is not strong enough to affect the waveforms. In contrast, CEy is semantically anomalous since the semantics of yooda requires the morpheme to be attached to the cause event of a cause-effect relation.
5.7.2. Modality and N400

We regard the posterior and central negativity observed as SFA × ROI interaction for daroo (Figure 8) as N400. Let us consider the frequencies of the two morphemes, yooda and daroo, because we compare them directly and the amplitude of the N400 is known to be affected by the frequency of words (Van Petten and Kutas, 1990). That is, infrequent morphemes elicit amplified N400 compared to high frequent ones. As seen in Section 4, however, daroo is more frequent than yooda in BCCWJ (30686 yooda sentences and 47538 daroo sentences). Since daroo, which is more frequent than yooda amplifies N400, the observed N400 cannot be explained in terms of the frequencies of the morphemes. Instead, we propose that the observed N400 is related to the processing of modality which involves processing of multiple possible worlds that poses increased processing demands. This accords well with the findings in the previous studies: Processing of English and German counterfactuals and modals elicit negativity, which is analyzed as an indication of increased processing costs. Dwivedi et al. (2006) report that hypothetical contexts in English elicit negative trend. Kulakova et al. (2014) observe that German subjunctives elicit LAN compared to indicatives. Kulakova and Nieuwland (2016) show that English counterfactuals elicit larger N400 compared to indicatives. We do not have much to say about the frontal positivity (FC5 in Figure 8(c)). Since this positivity is observed in the same time-window as the posterior negativity is observed, it might also reflect the semantic processing of modality.

An alternative interpretation to the semantic N400 is to interpret it as a result of lexical integration cost. The negativity for daroo condition can also be regarded as the positivity for the yooda condition. Since yooda is more frequently used in the Effect-Cause context as we pointed out in Section 4, its semantic integration might be less costly, which leads to less negativity of the yooda condition. This interpretation, however, does not explain why yooda in Cause-Effect condition elicits more negativity and cancels out the reduction of negativity in Effect-Cause context. We thus regard the semantic N400 interpretation as more favorable.

![Figure 8: N400 elicited by daroo](image)

5.7.3. Summary

We observe that the evidential auxiliary yooda which marks an inference from an effect state to a cause event elicited LAN. The alternative interpretation of the result is that the anomalous
CEy condition elicits N400/P600 effect of semantic anomaly and reanalysis. On the other hand, the modal auxiliary *daroo* elicits neither effects, even though introspection-based data suggests that ECd is anomalous. Our result demonstrates that causal inference involved in *daroo* is different from that of *yooda*. More specifically, ECd is pragmatically anomalous while CEy is semantically anomalous. Furthermore, our result reveals that processing of modality, which involves processing of multiple possible worlds, induces N400 effect.

6. Conclusion

Evidentiality and modality are very similar notions and often one is subsumed under the other. Davis and Hara (2014), however, argue that evidentiality and modality are separate categories and Hara (2017) offers a formal analysis of the Japanese evidential auxiliary *yooda* that lexically encodes the causal requirement in its semantics. *Yooda* is an evidential morpheme and $p$-*yooda* presupposes that there is information $q$ such that $p$ causes $q$ and asserts that the speaker perceives $q$ at the actual world $w@$. Hence, there is no quantification over possible worlds involved in the assertional content of $p$-*yooda*. In contrast, *daroo* is an epistemic necessity modal which involves universal quantification over possible worlds and its semantics does not encode the causal requirement. To conclude the paper, let us go back to our research questions:

(15) Research Question 1
Can we justify the theoretical claims by way of corpus/EEG studies?

(16) Research Question 2
Are there neural indices that indicate the computational difference between modals and evidentials?

First, the corpus and EEG studies support the idea that the interpretation of *yooda* is dependent on causality and evidentials and modals are separate categories. In the corpus study, *yooda* is more likely to follow cause-denoting predicates than state-denoting predicates. The corpus result also suggests that the interpretation of *daroo* is also dependent on causality since *daroo* is more likely to follow state-denoting predicates than cause-denoting predicates. However, the EEG study shows that the effect of causality is stronger in *yooda* than *daroo*. The ECy condition where the causal context matches the semantics of *yooda* elicits LAN (alternatively the anomalous CE condition elicits N400/P600 effect), while no effect is observed for the CEd and ECd conditions. This result is in accordance with our theoretical claim that *yooda* semantically presupposes a causal relation while *daroo* lacks such a presupposition. The seeming influence of causality in the introspection-based and corpus data is due to a pragmatic competition.

Regarding Research Question 2, we find LAN as an index of successful causal inference in evidentiality and N400 as an index of an increase of processing cost of modality, i.e., multiple possible worlds.

Finally, the study reported in this paper demonstrates that EEG plays a crucial role in dissociating semantic violations from pragmatic ones. Both the introspection-based approach and the corpus study show that the interpretation/distribution of *daroo* is dependent on causality just like *yooda*, but neither can distinguish the nature of the violations.

References


Abstract. In name-informing constructions like The phenomenon is called a “sun halo”, the noun mentioned in the quotation (a “sun halo”) adopts a referring interpretation, as indicated by the determiner. As an account, we claim predicates like call to introduce a copular relation, which is the source of referring uses of nominals in name-informing quotation: To call y “n” entails that y is an n. Two copula types are argued to be covertly contained in name-informing constructions, an identificational copula and an equative copula, and we put forward linguistic evidence in support of this distinction. Further, corpus data show that nouns quoted in a name-informing construction are more prone to be used with quotes when accompanied by a determiner. We interpret this to reflect a pragmatic strategy employed to highlight the expression’s mentioning use. Lastly, the quotations under discussion are differentiated from other types of quotation. Specifically, name-informing quotations are treated as instantiations of pure quotation, which we reason to be entailed compositionally and, although they can be referential hybrids, should not be subsumed either under open or mixed quotation.

Keywords: quotation, name, referring, copula.

1. Introduction

Quotation is a metalinguistic device used to talk about certain dimensions of language, see, e.g., Cappelen & Lepore (1997); Davidson (1979); Saka (1998). In quotational constructions, expressions are mentioned rather than or in addition to being used denotationally. With an assertion like in (1a), for example, in contrast to (1b), the syllabic setup of the word sofa is described and the quotation marks around sofa indicate this use, which means reference is made to a linguistic dimension of the quoted expression, see, e.g., Quine (1981).

(1) a. “Sofa” has two syllables.
   b. A sofa is a piece of furniture.

The referential difference between a denotationally used and a mentioned expression occurring in this type of quotation is reflected in the incompatibility of the mentioned noun with a determiner, as illustrated in (2).

(2) *A “sofa” has two syllables.

Observe, however, that in quotational constructions of the type in (3) below, the quoted noun does occur with a determiner.

(3) a. A couch is also referred to as a “sofa”.
   b. The phenomenon is called a “sun halo”.

---

1 I would like to thank Philippe De Brabanter, Ljudmila Geist, Marcel Schlechtweg, the audiences of the Sinn und Bedeutung 24 conference (Osnabrück) and the 11th Semantics and Philosophy in Europe Colloquium (Warsaw) as well as the editors for comments and suggestions. Thanks for technical support go to Melina Heinrichs and Marcel Linnenkohl.

The determiner is optional. A referring (i.e., denotational) use of the quoted noun is unexpected here, given that these quotations, similar to the one in (1a), inform the addressee about the (conventionalized) linguistic shape of the corresponding denotatum’s name, i.e., “sofa” and “sun halo”, respectively. Accusative case is assigned to the name, cf. German *Man nennt die Erscheinung einen / *ein “Sonnenring” (*one calls the phenomenon a_{ACC} / a_{NOM} “sun halo”), which suggests that the determiner is not a constituent part of the linguistic shape mentioned in the quotation\(^2\) and that we are dealing with a DP here. This raises the question about the origin of the referring interpretation of the mentioned names in these cases as well as the nature of the quotation at stake.

The current paper investigates name-informing constructions of the kind in (3) with a focus on their semantics and the type of quotation involved in them. Specifically, we argue that name-informing predicates like *call* introduce a copular relation entailed by the predicate: To call y “n” entails that y is an n, which we claim to be the source of referring uses of nominals in name-informing quotation. Linguistic evidence is put forward in support of this analysis as well as of the assumption of two distinct types of copula manifested in name-informing constructions, an identificational and an equative copula. Further, we present corpus data, which show that quoted nouns in name-informing constructions are more prone to be used with quotes when they are accompanied by a determiner. The effect is interpreted to reflect a pragmatic strategy highlighting the expression’s mentioning use. Finally, we consider the type of quotation involved in the constructions under discussion, which are reasoned to represent cases of pure quotation that emerges from the compositional properties of the name-informing predicate. Based on this, we conclude that name-informing quotation, although it can involve referential hybrids, should not be treated as either open or mixed quotation.

The structure of this paper is as follows. In section 2, the semantic properties of name-informing constructions are explored. The notion of a copular relation contained in them is introduced and linguistic evidence in support of this assumption as well as corpus data are presented. In section 3, we consider the type of quotation at work in name-informing constructions. Section 4 concludes our investigation.

2. Name-informing quotation

Quotations in name-informing constructions containing predicates like *call*, *name*, *refer to* etc., as embodied in (3) and also in (4) below, are used to display the linguistic shape of a concept’s conventionalized name.

\[(4) \begin{align*}
\text{a.} & \quad \text{One calls this disease “septicemia”}\,. \\
\text{b.} & \quad \text{A function that calls itself is named “recursive function”}\,. \\
\text{c.} & \quad \text{The purity of gold is referred to with the word “karat”}\,. 
\end{align*}\]

As argued in Härtl (2018), quotations of this sort are instances of pure quotation, i.e., a metalinguistic device used to demonstrate linguistic shapes in a rule-like fashion, see, e.g., David-

\(^2\) This assumption is also supported by data taken from the German DeReKo corpus (IDS Mannheim), which reveal that a determiner of a mentioned noun occurs almost never inside the quotation when quotation marks are used in constructions of the type in (3) in German.
son (1979); Cappelen & Lepore (1997); Maier (2014). A standard case of pure quotation is represented in the example in (1a) above. As an explication of their metalinguistic status, pure quotations can be preceded by appositions like the word, as exemplified in (4c).

2.1. The semantics of name-informing quotation

Predicates like call are three-place predicates, which require an argument that can be interpreted metalinguistically. In a case like (4a), for instance, call is used to describe a naming convention. The sentence asserts that some occurrence of blood poisoning (this disease) is commonly referred to as “septicemia”. Thus, call’s verbal root involves three thematic arguments, an agent x, which is bound generically here, a theme y and a relational argument that, in this case, introduces a shape “n” of the name of the theme argument y.

(5) a. \( x \text{ call- } y \text{ “n”} \)
   b. \( \lambda y \lambda n \lambda x [\text{CALL}(x, y, \text{NAME(“n”, y)})] \)
   c. \( \text{GEN}_x [\text{CALL}(x, \text{this disease}, \text{NAME(“septicemia”, this disease))}] \)

Naming predicates are highly polysemous, see, among others, Anderson (2004) and Biro (2012) for analyses. While name-informing sentences like the ones in (3) and (4) describe naming conventions, naming constructions can also be used to reflect a speaker attitude, see (6a), an act of baptizing as in (6b) or an act of nomination ((6c)).

(6) a. They called their son a liar.
   b. They named their son Arthur.
   c. He was named the president of the university.

While the semantic forms in (5) are meant to represent the meaning of call in its name-informing use, we believe an underspecification approach to be desirable, with the different manifestations of call to be derived compositionally. The verbal event and the agent argument have, for example, a generic meaning in naming-informing constructions like (4) but adopt a specific interpretation in the description of a speech act like (6a).

2.2. An underspecified copula in name-informing quotation

Matushansky (2008) and Fara (2015) have proposed a small-clause analysis of naming constructions like in They named their son Arthur, with \([sc[their\ son][Arthur]]\) as small clause, implying that proper names figure as predicates here. Evidence for this assumption comes, among other things, from the observation that the name in naming constructions does not combine with a determiner in languages like German, see (7a), where this option is generally available with argument uses of proper names as displayed in (7b). Observe that with common nouns as used in (7c), a determiner is not blocked in naming constructions in German, and above we have observed the same for name-informing constructions, cf. (3) and their German equivalents.

\footnote{For a decompositional analysis of the change-of-state readings of naming predicates, as represented in (6b & c), see Matushansky (2008).}
To address this puzzle, we propose name-informing constructions of the type in (3) and (4)\(^4\) to involve an underspecified copular relation \(P\) in the predicate’s verbal root. Crucially, it is this copula that introduces a referring nominal, manifested through the determiner. Consider the semantic form in (8).

\[(8)\quad \lambda P \lambda y \lambda n \lambda x \, \text{CALL}(x, y, \text{NAME}(“n”, y) \land P(n, y))\]

With our analysis, we assume \(P\) to identify the particular relation holding between the denotation of the name \(n\), mentioned as “\(n\)” in a name-informing construction, and the theme argument \(y\). Reconsider the example in (4a), repeated below, and notice that the denotation of the theme argument and the denotation of the name are identical in the corresponding discourse domain.

\[(9)\quad \text{a.} \quad \text{One calls this disease “septicemia”}\]
\[\quad \text{b.} \quad [[\text{this disease}]] = [[\text{septicemia}]]\]

The relation holding between the two arguments can be made explicit, see (10a), and cannot be negated, see (10b).

\[(10)\quad \text{a.} \quad \text{One calls this disease “septicemia” and this disease is a septicemia.}\]
\[\quad \text{b.} \quad \text{One calls this disease “septicemia” but this disease is not a septicemia.}\]

The contradiction produced in (10d) suggests that a relation of the type in (9b) is entailed as part of the truth-conditional meaning of the sentence in (9a).\(^5\)

The inclusion of a copular relation in naming constructions has been stated before, see Matsushansky (2008: 582, 590). From a functional syntactic angle, cf. Ágel (2017: 358ff.), German \textit{nennen} (‘call’), as used in (11) below, has been analyzed as a transitive copula verb, which involves an object predicative, i.e., \textit{einen Leerverkauf} (‘a short sale’). It assigns a property to

\(^{4}\) In the following, we focus on name-informing constructions and stay agnostic as to whether or how our analysis applies to (baptizing) uses of naming predicates involving proper names.

\(^{5}\) Note that the intended reading of the naming construction used in (10b) is a name-informing one, introducing a naming convention, and not one describing a vocative act as in, e.g., \textit{They mistakenly called this disease “septicemia” but this disease is not a septicemia}. We assume that with a sentence like (9a), the speaker “veridically commits” (see Giannakidou & Mari 2019) themselves to the truth of the assertion that the disease in question is indeed a septicemia.
the first object DP (diesen Vorgang, ‘this practice’) and both nominals are marked with accusative case.⁶

(11) Man nennt diesen Vorgang einen Leerverkauf.
    one calls this practice a short sale

An object predicative analysis for nennen (‘call’) is supported by the behavior of the two participating nominals in the passive voice. As opposed to double-accusative verbs in German like abfragen (‘test’),⁷ which take two referential DPs, see (12a), with nennen, both participating nominals are marked with nominative case in the passive, see (12b).

(12) a. Der Schüler wird den Wortschatz abgefragt.
    the student is the vocabulary tested
    ‘The student is tested on the vocabulary.’

b. Dieser Vorgang wird ein Leerverkauf genannt.⁸
    the practice is a short sale called
    ‘This practice is called a short sale.’

In the following section, we will take a closer look at the copular relation P implied in name-informing constructions and identify two distinct types of copulas figuring here as well as their grammatical manifestation.

2.2.1. Identificational copulas in name-informing constructions

The first type of copula we claim to be involved in name-informing constructions is the identificational copula.⁹ Typically, identificational copular sentences contain a demonstrative or definite nominal expression as subject and are used to teach the names of people or things, introduced in the postcopular phrase, see, among others, Higgins (1979); Mikkelsen (2011). Heller & Wolter (2008) argue that the postcopular expression in an identificational sentence denotes a sort or kind, respectively. This is also what we observe in the covert copular sentence contained in (13a) as it specifies the sort of the subject referent, see (13b).

(13) a. The phenomenon is called a “sun halo”.

b. The phenomenon is a sun halo.

c. λy GENs ... [SUN HALO(s, y)] (the phenomenon)

We assume the postcopular nominal to refer generically, as indicated by the generic operator in (13a) and (14). Thus, the generic operator is the source of the occurrence of the indefinite article in assertions like (13a & b). Further, it follows that the shape of the name in quotes

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⁶ We wish to thank Vilmos Ágel for his input on this subject matter.
⁷ See, for example, Czepluch (1988) for an analysis.
⁸ For a reason still unknown to us, the article use is somewhat marked with the second nominal in (12b). Without the article, the sentence is unmarked. The article use is also unmarked in the active voice, see (11).
⁹ We wish to thank Ljudmila Geist for the fruitful discussion of the proposed analysis and data at issue. For the different views on the taxonomy of copulas see, among others, Geist (2006); Heller (2005); Mikkelsen (2005).
“sun halo”) in (13a) is derived from the name of a kind. Similarities between kind-referring nouns and proper names have been pointed out by Krifka et al. (1995).

(14) GENs $\exists x \left[ \text{CALL}(x, \text{the phenomenon}, \text{NAME}(\text{“sun halo”, the phenomenon}) \land \text{SUN HALO}(s, \text{the phenomenon})) \right]$

The subject in identificational copular sentence has a different semantic type than the subject of predicational copular sentences, see Geist (2006) and Mikkelsen (2005) for analyses. This is reflected grammatically in the fact that the subject of a copular sentence like (13b) can only be referred to with a non-referential pronoun, e.g., in a left-dislocation configuration, see Mikkelsen (2005: 74f). Consider the German examples in (15) and observe that the dislocated subject cannot be referred to by the gender-matching, referential demonstrative pronoun *die* (‘theFEM’) but only by the non-referential neuter pronoun *das* (‘thatNEUT’).

   the phenomenonFEM thatNEUT / theFEM is a sun halo
b. Die Krankheit, *das* / *die* ist eine Septikämie.
   the diseaseFEM thatNEUT / theFEM is a septicemia

Identificational copular sentences are in sharp contrast here to predicational copular sentences. Consider example (16a).

(16) a. Die Kette ist ein Erbstück.
   ‘The necklace is an heirloom.’
   b. Die Kette, *die* ist ein Erbstück.
   the necklaceFEM theFEM is an heirloom
   ‘The necklace that is an heirloom.’

As (16b) illustrates, the subject of a predicational copular sentence can be referred to by means of a referential pronoun, i.e., *die* (‘theFEM’) in this case, thus reflecting the distinct referential properties of nominals involved in this type of copular sentence.

2.2.2. Equative copulas in name-informing constructions

A second type of copula we postulate to be involved in the constructions at stake is the equative copula. Name-informing constructions like those in (3b), repeated below as (17a), as well as (17b), entail equative copular sentences as given in (17a’) and, respectively, in (17b’). According to Higgins (1979), in equative copular sentences, the reference of the pre- and the postcopular nominal are the same, as represented in (18).10

(17) a. A couch is also referred to as a “sofa”.
   a.’ A couch is a sofa.

10 See, for example, Geist (2006) for an analysis. Equative copular sentences are also termed identity or equational clause in the literature, cf. Mikkelsen (2011) and others.
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b. A pullover is also called a “sweater”.
b.’ A pullover is a sweater.

(18) a. \( \lambda n \lambda y \ldots [y = n] \) \((a \text{ pullover}) \ (a \text{ sweater})\)
b. \(\text{GENs GENp } \exists x \ [\text{CALL}(x, \ a \text{ pullover}, \ \text{NAME(“sweater”, \ a \text{ pullover}))} \land \text{PULLOVER}(p) = \text{SWEATER}(s))\)

Observe that equative sentences of this type occur in left-dislocation configurations only with markedness. Consider the following examples.\(^{11}\)

(19) a. ??A couch that is a sofa.
b. ??A pullover that is a sweater.

In comparison to identificational and predicational copular sentences, left dislocation is generally marked with equative copular sentences. Sentences of the type in (19) are acceptable only if specific use conditions are met. If somebody, perhaps a non-native speaker of English, does not know the word couch, the use of (19a), for instance, could be appropriate in response to a question like (20a).\(^{12}\)

(20) a. A: What is a “couch”? I have never heard that word before!
b. B: Oh, a “couch” that is just a sofa!

Note, however, that (20b) is embedded in a metalinguistic discourse and has a translational function, and it is this restriction which licenses the subject DP to occur as a hanging topic. Outside such contexts, (19a & b) are uninformative.\(^{13}\) Left dislocation is typically used to topicalize a constituent or, respectively, emphasize a topic constituent, see, for example, Ebert & Hinterwimmer (2009). In the resulting topic-comment structure, the comment expresses a property, which is predicated of the topic referent. In equative copular sentences, the pre- and the postcopular nominal are referentially equated, and a sentence like A couch is a sofa is truth-conditionally equivalent to the sentence A sofa is a couch, with a reversed constituent order.\(^{14}\) It follows that left dislocation produces an informationally empty interpretation here, in which a topic referent is highlighted with respect to having the property of being itself.\(^{15}\)

Supporting evidence for our assumption that name-informing sentences like (17a & b) involve a different type of copula comes from the observation that, as a lexical reflector, they require the additive particle also or a semantic equivalent thereof. In name-informing con-

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\(^{11}\) Acceptability judgements for examples of the type in (9) vary. If we follow our informants, the construction’s equivalents seem to be less acceptable in German as compared to English and French.

\(^{12}\) We wish to thank Gillian Ramchand for the example in (20).

\(^{13}\) Observe also that in an exchange like (20) the corresponding name-informing paraphrase for (20b) is A sofa is also referred to as a “couch” in English and not A couch is also referred to as a “sofa” in English, indicating that (20b) is in fact not the left-dislocation equivalent of (17a/a’).

\(^{14}\) For an analysis on the reversibility of constituents in copular sentences see, for example, Declerck (1988).

\(^{15}\) We thank Stefan Hinterwimmer for the discussion on this issue.
texts, also, based on Szwedek (1991), entails that a name for \( y \) exists, which is included in the set of (other) names used for \( y \).

(21)  
\[ a. \text{A couch is also referred to as a “sofa”}. \]  
\[ b. [[also] \rightarrow \text{NAME(“sofa”, \( y \)) \in \{\text{NAME(“couch”, \( y \)}, \text{NAME(“n”\(_{i+1}\), \( y \)} \ldots\}] \]

When omitting also in sentences of this sort, a different meaning of the name-informing construction is conveyed. The examples in (22) illustrate this.

(22)  
\[ a. \text{A couch is referred to as a “sofa” (in this warehouse)}. \]  
\[ b. \text{A pullover is called a “sweater” (in this store)}. \]

While, for example, (21a) has a paraphrase along the lines of “things called “couch” in speech community A are, in addition, called “sofa” in speech community B”, with the latter materialized as the domain of a warehouse in the example.\(^\text{16}\) (22b) works analogously.

Crucially, in name-informing sentences involving an identificational copula, also is entirely optional and, hence, its absence does not produce a difference in meaning, as illustrated in (23).\(^\text{17}\)

(23)  
\[ a. \text{The phenomenon is (also) called a “sun halo”}. \]  
\[ b. \text{The purity of gold is (also) referred to with the word “karat”}. \]

Here, the meaning of also does not entail that the denotata in question are called either “phenomenon” or “sun halo” and, respectively, “purity of gold” or “karat”. Rather, also implies that “sun halo” and “karat” are included in an alternative set of other, not specified names used for the denotata in question.

(24)  
\[ a. \text{The phenomenon is also called a “sun halo”}. \]  
\[ b. [[also] \rightarrow \text{NAME(“sun halo”, \( y \)) \in \{\text{NAME(“n”\(_{i}\), \( y \)}, \text{NAME(“n”\(_{i+1}\), \( y \)} \ldots\}] \]

The optionality of also is explained here by its redundancy in such contexts as the existence of alternative names for things can usually be taken for granted by competent members of a speech community.

We have identified two distinct types of copula involved in name-informing quotation, an identificational copula and equative copula, and presented linguistic reflectors of the distinction. Our proposal implies that the copula contained in the semantics of a name-informing construction entails a (generically) referring interpretation of the quoted nominal, which, in turn, is the source for the use of a determiner with this nominal.

\(^{16}\) The sentences in (22), which again have a translational meaning, can be speculated to involve an identificational copula in fact, as discussed in the previous section. We leave this issue for future research.

\(^{17}\) The reading of also as a speech act adverb (cf. Also, the phenomenon is called a “sun halo”) is not intended in (23). We thank one of the editors for pointing out this reading of also.
2.2.3. Correlations between determiner occurrence, auch (‘also’), and the use of quotes

In this section, we will take an empirical look at the interplay between the occurrence of a determiner and the additive particle in a name-informing construction, on the one hand, and the use of quotation marks, on the other. Quotes and their material realization, respectively, are a device used to draw the addressee’s attention to the mentioning use of an expression. Pragmatic approaches, which we follow here, implement quotes as pragmatic markers used to indicate a deviation from the standard, denotational use of an expression and give rise to a non-stereotypical interpretation instead, see, e.g., Gutzmann & Stei (2009); Härtl (2018); Klockow (1978). Besides pure quotation, see (25a) below, quotes are commonly used to signal scare quotation, see (25b), direct quotation, (25b), as well as mixed quotation, (25d).

(25) a. “Sofa” has two syllables.
      b. The “beach” was in fact a thin strip of black volcanic grit.
      c. “Something is wrong”, Alan whispered softly to his dolls.
      d. The coach declared that his team would “kick arse” today.

A standard definition of their semantics holds that quotations refer to the expression inside the quotes reflexively, see Ludwig & Ray (2017: 102). There is a debate in the literature about the status of quotes in the compositional structure of a quotation. In semantic analyses, quotes, or their meaning equivalent, are typically assumed to be an essential part of a quotational construction, see, e.g., Predelli (2003). In contrast, pragmatic approaches argue that contextual clues alone are sufficient to construe a quotational meaning, which is also used to explain why quotes are optional, see, e.g., De Brabanter (2013); Washington (1992). 18

A pragmatic approach towards quotes entails that their manifestation is context-sensitive. As regards name-informing quotations, the occurrence of a referring noun accompanied by a determiner can be hypothesized to correlate with a higher rate of quotes, reflecting a compensating strategy to highlight the name’s metalinguistic use in the underlying copular sentence (Hypothesis H A). A reversed correlation can be expected to hold between the occurrence of the (German) additive particle auch (‘also’) and the occurrence of quotes, as auch alone highlights the mentioning use of the quoted material, considering that auch entails alternative shapes of names (Hypothesis H B).

In order to test hypothesis H A and H B, we conducted two corpus studies. In the pilot study, sentences containing the verbs bezeichnen (‘refer to as’) and nennen (‘call’), each n=500, were randomly extracted from the German DeReKo corpus (IDS Mannheim). From each set, all sentences with a name-informing semantics were selected as valid hits based on predetermined annotation guidelines and classified with respect to the occurrence of determiners (definite / indefinite) as well as auch in them. The occurrence of quotes was taken to be the dependent variable.

18 In semantic approaches, the expression of a semantic equivalent of quotes is not optional as they are always encoded, either silently or through additional indicators, e.g., through air quotes or acoustic means, cf. Schlechtweg & Härtl (2019).
As a result, in the sentences containing *bezeichnen* (*n*=163), 29 included *auch* in the relevant sense, and in ten of these (34 %) quotes occurred around the mentioned nominal. In sentences without *auch*, the mentioned nominal was embraced by quotes in 23 cases (17 %). A reversed correlation was observed with *nennen* (*n*=174). Here, in sentences containing *auch* (*n*=36), the mentioned nominal occurred in quotes in six of the cases (16 %), whereas in sentences without *auch*, the mentioned nominal was in quotes in 40 % of the cases. As concerns the occurrence of a determiner, only sentences involving *nennen* yielded noteworthy output. In eleven cases, the mentioned nominal occurred with a determiner, from which six (54 %) were in quotes. When no determiner occurred, only 34 per cent of the mentioned nominals were enclosed by quotes.

As the data collected so far delivered conflicting results and, respectively, cannot be reliably used to verify the hypotheses, a follow-up study was conducted using a larger-scale data set and a more restricted search pattern. Specifically, only sentences with the verb *nennen* were retrieved which exhibited the pattern ‘*man nennt y (auch) n*’ (*one calls y (also) n*), with and without *auch*, each *n*=500. The results of the analysis are displayed below. Figure 1 below shows the correlations between the occurrence of *auch* and quotes as well as the occurrence of a determiner (with determiner *n*=296) and quotes in name-informing constructions involving the verb *nennen*.

![Figure 1: Correlations between quote occurrence and ‘auch’ / determiner](image)

The results indicate that the occurrence of *auch* in this type of name-informing construction does not affect the probability of quotes to occur around the mentioned nominal, *t*(1)=1.9, *p*<.16, and Hypothesis H₈ must thus be rejected. We conclude that *auch* is not a predictor for the use of quotes. In contrast, the occurrence of a determiner did have an effect on the occurrence of quotes, *t*(1)=32.5, *p*<.001. The null hypothesis must thus be rejected and the alternative hypothesis (H₉) accepted. We interpret these results to reflect a compensating pragmatic strategy. It aims at highlighting the metalinguistic status of the mentioned expression, when the expression strongly suggests a denotational interpretation signaled by the determiner as constituent part of the copular relation introduced by *nennen*.

The above results are better compatible with pragmatic, use-conditional approaches towards quotes, in which their manifestation is sensitive to context. Therefore, in name-informing constructions, which instantiate pure quotation, whether quotes are manifested or not depends...
on the presence of a determiner accompanying the mentioned nominal. Note that our conclusion rests on the assumption that quotations in name-informing constructions used with and without determiner are both instances of pure quotation. This premise, however, may not be uncontroversial. We address this issue in the next section.

3. Type of quotation

We assume quotations of the type under discussion to involve pure quotation, i.e., a metalinguistic device used to demonstrate linguistic shapes in a rule-like fashion, but this theoretical perspective is not without alternative. Consider the example in (26), taken from Recanati (2001: 682).

(26) A “fortnight” is a period of fourteen days.

Recanati analyzes quotations of this type as, what he calls, open quotations. With this type, the expression inside the quotes contributes to the semantic content of the rest of the sentence, which, in turn, explains the referring use of the quoted nominal. Open quotations are not recruited as singular terms, as opposed to closed quotations, e.g., “Fortnight” is an unfamiliar word, which figure as singular terms in the compositional structure (Recanati 2001: 682f.).

Crucially, sentences of type in (26) are not assertions explicitly “about words”, see Recanati (2008: 446) and, thus, the interpretation of the quotes to metalinguistically demonstrate a somehow special word here, i.e., fortnight, is derived through pragmatic inferencing. This inference, as noted in De Brabanter (2013: 138), can be explicated by means of metalinguistic appositions like as one says in English, cf. A “fortnight”, as one says in English, is a period of fourteen days. In that sense, quotations like in (26) are similar to pure quotations, as they ascribe properties to words, see Recanati (2001: 683), and presuppose some kind of generic English speaker, see De Brabanter (2013: 138).

Does this imply that quotations of the type under discussion here should be treated as instances of open quotations, whose interpretation is derived pragmatically? Certainly not. Consider below the name-informing equivalent of (26).

(27) A period of fourteen days is called a “fortnight”.

Observe that in this sentence, the assertion, other than the one in (26), is indeed about a word. As discussed in section 2.1. above, predicates like call require a mentioned expression as complement, which provides the shape, in this case “fortnight”, of the name of the theme argument, i.e., a period of fourteen days. Inverted commas around the name argument are used to explicate this meaning. So, the quotational meaning in constructions of this sort is rooted in the combinatorial properties of the verbal predicate. At the same time, call, as claimed above, introduces a copular relation, which we argued to be the source of the quoted nominal’s referring use.
We assume that name-informing constructions entail pure quotation compositionally.\textsuperscript{19} It is another open question, though, whether hybrid uses, where, as in (27), the name argument is both mentioned and used referringly are in fact instances of what is known as mixed quotation in the literature, see, e.g., Davidson (1979). Consider the example in (25d), repeated below.

(28) The coach declared that his team would “kick arse” today.

In sentences containing mixed quotation, an expression, in this case an idiomatic verb phrase, is used denotationally as the predicate of the clause and, simultaneously, mentioned to report a specific linguistic expression uttered by the coach. Hence, direct and indirect speech are combined in clauses involving mixed quotation, see Cappelen and Lepore (1997); Maier (2007). Geurts & Maier (2005) propose to treat mixed quotations of this sort to involve a meaning shift where quoting expression \( n \) entails something like ‘what \( x \) calls ‘“n”’, with the value of \( x \) to be determined contextually, i.e., by the subject DP the coach in (28). The analysis implies that the presence of the quotes creates a speaker shift such that if the quotes are present \( x \)’s uttering the expression in quotes is reported. If the quotes are not present, the corresponding expression is interpreted to be uttered by the speaker of the sentence.\textsuperscript{20} Crucially, we do not observe such a shift in meaning with quotations in name-informing constructions. Consider (29).

(29) The phenomenon is called a sun halo / a “sun halo”.

Although the two realizations may differ with respect to their suitability, they both entail a paraphrase along the lines of ‘what the competent speaker of speech community A calls “sun halo”’, regardless of the presence of quotes. The reason for this is, again, that predicates like call entail a metalinguistic argument compositionally and, hence, quotes have a pragmatic function here. We conclude that, although name-informing quotation involves hybrid, denotational and mentioning uses of expressions, these are not instantiations of mixed quotation in the narrow sense.

4. Conclusion

We have argued name-informing constructions containing predicates like call, name, refer to etc. to introduce a copular relation. To call \( y \) “\( n \)” entails that \( y \) is an \( n \). This copular relation is the source of referring uses of nominals in name-informing quotations as in, e.g., The phenomenon is called a “sun halo” or A couch is also referred to as a “sofa”. Two distinct types of copulas are involved in name-informing constructions. While the former above example is an instantiation of, as we claim, an identificational copula, the latter involves an equative copula. Linguistic evidence put forward in support of these assumptions includes truth-condi-

\textsuperscript{19} Recall that it does not follow from this that quotes materialize obligatorily here as they can also be present silently, cf. footnote 18. Furthermore, the quotes used in name-informing quotation can sometimes also adopt a scare-quote interpretation, as, possibly, in This yoga position is called a “tree”, which supports the notion of an underspecified, pragmatic function of quotes.

\textsuperscript{20} The truth-conditional effects this shift brings about are discussed in, among others, Cappelen & Lepore (1997); De Brabanter (2013).
tional effects, left-dislocation configurations as well as the presence of the additive particle *also*. The corpus data we collected show that nouns mentioned in name-informing constructions are more prone to be used with quotes when they are accompanied by a determiner, i.e., when they are used referentially. This effect was interpreted to reflect a compensating pragmatic strategy to highlight the mentioning use of the expression. Finally, we claim the type of quotation under discussion to represent pure quotation, which is rooted in the compositional properties of name-informing predicates and is not a result of pragmatic inferencing. Based on this, we concluded that name-informing quotation, although they can be referential hybrids, should not be treated as either open or mixed quotation.

References


Individuating beliefs: DP objects of attitude verbs and their domains of quantification\textsuperscript{1}

Nina HASLINGER — Georg-August-Universität Göttingen

Abstract. Attitude predicates can take DP arguments that seem to quantify over propositions. But letting the DPs range over arbitrary propositions predicts incorrect truth conditions when combined with a standard possible-worlds semantics for attitude verbs. Here, I develop a new descriptive generalization characterizing the relevant propositions: Each set \( S \) of propositions the determiner combines with is restricted to those propositions that partially answer a question in a certain set, and are ‘minimal’ within \( S \) among the partial answers to that question. The set of questions is derived from the Hamblin sets of questions raised in the context. While this paper does not provide a full analysis, I argue that the effects of this generalization are not limited to attitude predicates, suggesting that it reflects a more general property of DP quantification.

Keywords: propositional attitudes, monotonicity, DP quantification, context-dependency.

1. Introduction

A property of attitude predicates that has received relatively little attention in linguistic semantics (but see e.g. Moltmann 2008, 2013; Elliott 2017) is their ability to combine with DP arguments, especially quantificational DPs like \textit{something} in (1a) and \textit{the same thing} in (1b).

\begin{align*}
(1) & \quad \text{a. John believes something Mary (also) believes.} \\
& \quad \text{b. John and Mary believe the same thing.}
\end{align*}

Since such DPs appear to quantify over potential attitude contents, they have attracted the attention of philosophers interested in the question whether the ontology underlying natural language semantics must include abstract objects encoding attitude contents, like propositions (e.g. Quine 1960; cf. also Geach 1972). Quine (1960: §44) ultimately dismisses the relevance of such examples because of “how uncertain one feels about sufficient conditions for identity of objects of the propositional attitudes”. The goal of this paper is to investigate the linguistic phenomenon behind this uncertainty – the contribution of context to the truth conditions of sentences like (1). Examples will mostly come from German, which is not to say that German is special in this respect; to my knowledge, there is no cross-linguistic study of this topic.

The focus will be on two classes of examples, which I call \textbf{restricted higher-order existentials} (exemplified by (1a) and (2a)) and \textbf{higher-order identity statements} (exemplified by (1b) and (2b)). In the former, an indefinite DP in an opaque argument position contains a relative clause with a gap in another opaque argument position – the object position of \textit{glauben} ‘believe‘ in (2a). The latter are sentences in which \textit{the same thing(s)/dasselbe} in an opaque argument position has what Beck (2000) calls an ‘NP-dependent reading’ relative to a plural expression.

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As the term ‘higher-order’ suggests, my starting point is a somewhat naive approach to the ontological issue just mentioned: I follow Hintikka (1969) in taking attitude verbs to combine with propositions, which are modeled as functions from possible worlds to truth values. Within this framework, Elliott (2017) argues that sentences like (1) and (2) involve quantification over genuine propositions rather than individuals or events associated with propositional content (see also Section 6). Following him, I take (1) and (2) to involve DPs that denote or quantify over propositions, which I call higher-order DPs (hDPs). This general picture raises two questions: Which propositions do the hDPs in (2a,b) quantify over? And are there constraints on these propositions that go beyond the usual contextual variability of the domains of natural language quantifiers? In this paper, I will concentrate on establishing two descriptive claims: I) The reason the truth conditions of (2a,b) are so elusive is that they are context-dependent. The set of propositions quantified over systematically depends on a contextual parameter whose value is a question meaning; more specifically, it only contains propositions that partially answer that question. II) Not all partial answers to that question have the same status: Certain answers are ‘too weak’ to be in the domain of the hDP, a phenomenon first discussed in Zimmermann’s (2006) work on intensional transitive verbs that I call the non-monotonicity effect.

The paper is structured as follows. After showing that the non-monotonicity effect extends to attitude predicates in Section 2, I motivate the claim that hDPs depend on a question parameter, using higher-order identity statements (Section 3). In Sections 4 and 5, I show that this context-dependency is not enough to account for the truth conditions of restricted higher-order existentials, and develop a descriptive generalization about the conditions under which the non-monotonicity effect arises in restricted higher-order existentials with believe. Finally, in Section 6, I argue that the non-monotonicity effect is not specific to hDPs and propose a second descriptive generalization about the class of predicates that give rise to it. In Section 7, I conclude and mention various unresolved questions.

2. The non-monotonicity effect

My starting point will be Hintikka’s (1969) analysis of attitude verbs like believe as universal quantifiers over possible worlds (3).\footnote{This class of expressions is called ‘propositional DPs’ by Elliott (2017) and ‘special quantifiers/special pronouns’ by Moltmann (2008, 2013).}

\[(3) \quad \begin{align*}
\text{a. } & \{\text{believe}\} = \{\text{glauben}\} = \lambda w.\lambda p_{(x,t)}.\lambda x.\forall w'[w' \in \text{DOX}(w)(x) \rightarrow p(w')] \\
\text{b. } & \text{DOX}(w)(x) = \{w' \mid w' \text{ is compatible with } x \text{'s beliefs in } w\}\end{align*} \]
This analysis has a serious problem with sentences like (1a). Consider a ‘naive’ semantics for (1a) based on my present assumptions. The indefinite hDP denotes an existential quantifier over propositions. For simplicity, I will decompose something into an existential determiner and a noun –thing with no lexical semantic content, both of which have meanings given by cross-categorial schemata (4a,b). The relative clause then involves a trace of type ⟨(s,t),t⟩ in the object position of believe. This gives us the LF in (4c), which denotes the proposition in (4d).

(4) a. For any type a: \( [\exists_a] = \lambda w. \lambda. P_{(a,t)}. \lambda. D_{(a,t)}. \exists x_a [P_{(x)} \land D_{(x)}] \)

b. For any type a: \( [\text{-thing}_{(a,t)}] = [\text{-was}_{(a,t)}] = \lambda w. \lambda x_a.1 \)

c. \( [\exists_{(s,t)} \text{-thing}_{(s,t),t} ([2,(s,t)]) \text{Mary} \text{believes} t_{(2,(s,t))}]] \) \( [1,(s,t)] \) \( \text{John} \text{believes} t_{(1,(s,t))}]] \)

d. \( \lambda w. \exists p_{(s,t)} [\forall w' [w' \in \text{DOX}(w)(\text{mary}) \rightarrow p(w')] \land \forall w' [w' \in \text{DOX}(w)(\text{john}) \rightarrow p(w')] \)

The problem is that (4d) is trivially true. This is because the verb meaning in (3a) is upward-monotonic with respect to its propositional argument: For any individual x, world w and propositions p and q, if [believe](w)(p)(x) and p entails q (p \( \subseteq \) q), then we also have [believe](w)(q)(x). This property has some linguistic motivation – for instance, (5) is odd, if not contradictory.

(5) \#John believes it is raining heavily, but he does not believe it is raining.

Let us now take an arbitrary proposition p such that [believe](w_0)(p)(\text{mary}) holds and an arbitrary proposition q such that [believe](w_0)(q)(\text{john}) holds. (Given the semantics in (3a), such propositions can always be found since any individual x ‘believes’ DOX(w_0)(x) in w_0.) Since p entails the disjunction p \( \lor \) q, we have [believe](w_0)(p \( \lor \) q)(\text{john}) due to upward-monotonicity. Along the same lines, [believe](w_0)(p \( \lor \) q)(\text{mary}). So there is at least one proposition – p \( \lor \) q – that satisfies the existential statement in (4d), regardless of whether John’s and Mary’s epistemic states intuitively have anything in common. The actual truth conditions of restricted higher-order existentials involving believe and its German counterpart glauben therefore do not seem to reflect the monotonicity properties these predicates intuitively have, a phenomenon I call the non-monotonicity effect.

The first detailed study of this effect, Zimmermann (2006), concentrated on intensional transitive predicates like look for which, if analyzed as in Montague (1974) or Zimmermann (1993), are also upward-monotonic with respect to their opaque argument position. Zimmermann notes that an upward-monotonic predicate meaning, when combined with a semantics for the DP that involves unrestricted quantification over the type of the opaque complement, predicts (6) to be true whenever John is engaged in a search and Mary is engaged in another search, even if the goals of their searches are completely unrelated.

(6) John is looking for something that Mary is looking for (too).

Since the intuitive truth conditions of (6) are stronger than that and (1a) appears to be non-trivial, there must be something wrong with the DP semantics in (4) or with our standard assumptions about monotonicity properties of opaque predicates. For (6), Zimmermann (2006) proposes to reject the assumption that look for is lexically upward-monotonic. While his approach to look for can be extended to attitude verbs, this would require an analysis of ordinary complement clauses as quantifiers over propositions to account for the effect of upward-monotonicity in examples like (5). As discussed in Haslinger (2019: ch. 6), this requires a
radical revision of the LF syntax and semantics of attitude complements. In this paper, I therefore want to explore a different possibility, namely that the effect is due to DP semantics and connected to an empirical property of examples like (1a) that I have ignored so far: the contextual variability of their domains of quantification. Let us model this by giving the determiner an additional argument position which is filled by a variable of the same type as its restrictor and its nuclear scope – in the case of (1a), a set of propositions. (1a) would then have the LF in (7b) with the interpretation in (7c).

(7) a. For any type $a$: $[[\exists x]a] = \lambda w.\lambda x.e_{(a,t)} \cdot \lambda .p_{(a,t)} \cdot \lambda .q_{(a,t)} \cdot \lambda x[q (x) \land p (x) \land q (x)]$

b. $[[\exists x a]C_{(3, (s, t), t)}] \cdot t \cdot \text{thing}_{(s, t), t} [(2, (s, t)) [\text{Mary believes} \ t_{2, (s, t)}]]] ((1, (s, t)) [\text{John believes} \ t_{1, (s, t)}])]]

c. $[[7b]]^g = \lambda w.\exists p_{(s, t)} [p \in g(3, (s, t), t) \land w' \in \text{DOX}(w) (\text{mary}) \rightarrow p(w')]$

$\land \forall w'[w' \in \text{DOX}(w) (\text{john}) \rightarrow p(w')]$

Crucially, if $g(3, (s, t), t)$ happens to be a set of propositions that is not closed under disjunction, (7c) comes out as non-trivial in spite of the upward-monotonic verb semantics. The question, then, is i) whether there is independent support for this context-dependency and ii) if so, whether this is all we need to derive the non-monotonicity effect. I will argue for a positive answer to question i) in Section 3 and for a negative answer to ii) in Section 4.

3. Domain restriction via contextually provided questions

To bring out the contribution of context to the interpretation of hDPs, let us first focus on a seemingly analogous puzzle about higher-order identity statements like (2b). Since the NP-dependent reading of same/dasselbe gives rise to a compositionality problem beyond the scope of this paper, I will simply give a denotation for the VP dasselbe glauben ‘believe the same thing’ that lets it take a plural individual as its subject (8). Given (8), (2b) is predicted to be true iff the set of propositions Peter believes is the same as the set of propositions Maria believes. This is to say that their epistemic states are identical, which is clearly too strong.

(8) $[[\text{dasselbe glauben}] = \lambda w.\lambda x.e_{(s, t), t} \cdot \forall y \in x \rightarrow \{p_{(s, t)} \mid [[\text{glauben}]] (w) (p) (y)\}] = S$

where $\leq a$ is the atomic-part relation on individuals (cf. Link 1983)

As before, we could address this problem by assuming that dasselbe actually compares only those of Peter’s and Maria’s beliefs that are in a contextually given set of propositions. Like the indefinite in (7b), dasselbe could introduce a domain-restriction variable that is mapped to a set of propositions by the variable assignment:

(9) $[[\text{dasselbe} C_{(i, (s, t), t)}] \cdot \text{glauben}]^g = \lambda w.\lambda x.e_{(s, t), t} \cdot \forall y \in x \rightarrow \{p_{(s, t)} \mid p \in g(i, (s, t), t) \land [[\text{glauben}]] (w) (p) (y)\}] = S$

If so, we should be able to see clear effects of contextual domain restriction once the broader discourse context provides a value for $C_{(i, (s, t), t)}$. As an illustration, consider the dialogue in

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4 According to Ede Zimmermann (p.c.), the observation that this puzzle extends to attitude predicates was independently made by Maribel Romero.

5 Whether the idea that restricted higher-order existentials are non-trivial due to contextual domain restriction can be extended to Zimmermann’s (2006) original examples, like (6), is not obvious. While these are context-dependent too (see Haslinger 2019: 93ff.), this context-dependency is harder to study systematically, since unspecific complements of look for arguably denote properties or quantifiers. While a set of propositions can be made salient by asking a question, the linguistic means of making sets of properties salient are less well understood.
(11) – where speaker A is clearly asking for beliefs relevant to the question who will make it to the final – in scenarios (10a) and (10b).

(10) **SCENARIOS**: Peter and Maria are German soccer ‘experts’ who were just interviewed on TV about the upcoming World Cup final.

a. Peter believes Germany will play Brazil in the final and Germany will win. Maria believes Germany will play Brazil and Brazil will win.

b. Peter believes Germany will play Brazil in the final. Maria believes France will play Brazil.

(11) a. [A: The big question is who will make it to the final. What do our experts think?]

b. B: Peter und Maria glauben dasselbe . . .

‘Peter and Maria believe the same thing.’ *true* in (10a), *false* in (10b)

The fact that (11b) can be judged true in scenario (10a) shows that it does not involve quantification over arbitrary propositions: Even if Peter and Maria disagree on the question who will win the final, what matters is that their answers to the question posed in (11a) are the same. In contrast, (11b) is most naturally judged false in scenario (10b), which suggests that it is not enough if Peter and Maria agree on *some* partial answer to that question (the contrast becomes more clear-cut with *genau dasselbe* ‘exactly the same thing(s)’). At this point, a plausible generalization is that in a context like (11a), which explicitly asks for beliefs ‘about’ a certain question $Q$, the quantificational domain is restricted to propositions that partially answer $Q$:

(12) **hDP Generalization 1 (to be revised)**

hDPs that quantify over propositions involve a contextual parameter whose value is a question extension $Q$. Their domain is restricted to the set of partial answers to $Q$.

The relevant notion of partial answerhood can be defined as follows. I take question extensions to be sets of propositions along the lines of Hamblin (1973), e.g. $[[\text{Brazil will be in the final}]](w_0) = \{[[\text{Germany will be in the final}]], [[\text{Brazil will be in the final}]], \ldots \}$. Against this background, we can define a strongly exhaustive answer to a question extension $Q$ as a proposition that specifies for each element of $Q$’s Hamblin set whether or not it is true and does not provide any other information (13). A partial answer is then a non-trivial disjunction of strongly exhaustive answers (14). Note that unlike the notion of ‘weakly exhaustive answer’, (14) permits arbitrary Boolean combinations of the elements of the Hamblin set, including their negations.

(13) The set $\text{SEA}(Q)$ of strongly exhaustive answers to a question extension $Q$ is defined as

$$\{ (\lambda w. \forall p \in S. p(w) \land \forall p \in Q \setminus S. \neg p(w)) \mid S \subseteq Q \}.$$  

(14) The set $\text{PA}(Q)$ of partial answers to a question extension $Q$ is defined as

$$\{ \forall R \mid R \subset \text{SEA}(Q) \land R \neq \emptyset \}.$$  

That hDPs are not just sensitive to strongly exhaustive answers is shown by the contrast in (15), where neither scenario involves a subject who believes a strongly exhaustive answer.

(15) a. **SCENARIO**: Peter and Maria both believe that Germany will be in the final, but they have no opinion about the second finalist. (11b) *true*

b. **SCENARIO**: Peter believes Germany will be in the final. Maria believes Brazil will make it. Neither of them has an opinion about the second finalist. (11b) *false*
Adverbials like *was die Frage Q betrifft* ‘concerning the question Q’ or *zur Frage Q* ‘as for the question Q’ allow us to explicitly shift the question parameter of a hDP. For instance, the modifier in (16) seems to have the same effect as the context in (10) and (11a). From now on, I will concentrate on examples with such modifiers. However, the parameter explicitly shifted in (16) is implicitly present in sentences without the modifiers as well. Arguably, this is why the truth value of such sentences is hard to judge when they are presented with little or no context.

(16) *Zur Frage, wer ins Finale kommt, glauben Peter und Maria dasselbe.*

‘Concerning the question who will make it to the final, Peter and Maria believe the same thing.’

true in (10a), false in (10b)

According to (12), a hDP restricted by a question Q quantifies over the actual partial answers, but not over other propositions that are relevant to Q in the sense that they entail a partial answer. This is confirmed by examples like (17b), where propositions like *[John owns a red car]* cannot be in the domain of *dasselbe* (if they were, (17b) would be false in scenario (17a)).

(17) a. **SCENARIO**: Anna and Brit are organizing a car parade in their village. They need to find out who owns a car and what colors the cars are. The local authorities have now given them an exhaustive list of all car owners. But the authorities have no data about the colors of the cars. Brit has now found out the colors of most cars, but she has not told Anna yet. Anna does not know the color of any car.

b. *Zur Frage, wer hier ein Auto besitzt, wissen Anna und Brit dasselbe.*

‘As for the question who owns a car here, Anna and Brit know the same thing(s).’

true in (17a)

In sum, at least for *glauben*[^6], generalization (12) is a good approximation of the truth conditions of higher-order identity statements. We will now see that restricted higher-order existentials are subject to non-trivial additional restrictions that do not follow from (12).

4. **The non-monotonicity effect revisited: Domain restriction is not enough**

(12) makes a clear prediction about our motivating example (2a): It should be true relative to a question Q iff there is at least one partial answer to Q that Peter and Maria both believe. But once a broader range of scenarios is considered, we find a more complex pattern, illustrated in (19). This section will focus on the contrast between what I will call the ‘*a ∨ b/a ∨ b* scenario’ (19a) and the ‘*a/b* scenario’ (19b); scenario (19c) will be considered in Section 5.

[^6]: With attitude predicates like *wissen* ‘know’ (but, at least in my judgment, not for *glauben* ‘believe’), hDPs appear to have a reading on which they do not range over partial answers at all, but rather over ‘pieces of evidence’ that might be relevant to answering the question. This is illustrated by (ib), which would be false in scenario (ia) if the hDP *fast alles* ‘almost everything’ quantified over partial answers. I think that a broader study of the linguistic differences between knowledge and belief attributions is needed to understand this reading.

(i) a. **SCENARIO**: Anna is studying the question which MPs will keep their seats after the next election. She is familiar with almost all of the available information, including polls and interviews with the MPs and their staff, but she still cannot make reliable predictions about most of the seats.

b. *Zur Frage, wer wiedergewählt wird, weiß die Anna fast alles.*

‘As for the question who will be reelected, Anna knows almost everything.’ can be true in (ia)
Let $a, b$ and $c$ be the propositions $[\text{Ada will come}], [\text{Brit will come}]$ and $[\text{Carl will come}]$, respectively. If the domain of the $wh$-phrase in (18) is restricted to Ada, Brit and Carl, the embedded question has the Hamblin set $Q = \{a, b, c\}$. The disjunction $a \lor b$ is then a partial answer to $Q$. Generalization (12) therefore correctly predicts (18) to be true in the $a \lor b$/a/$\lor$/$b$ scenario (19a). In the $a$/$b$ scenario, however, (18) is most naturally judged false even though we have $[\text{believe}](w_0)(a \lor b)($Peter$)$ and $[\text{believe}](w_0)(a \lor b)(\text{Maria})$ due to upward-monotonicity. Why does the partial answer $a \lor b$ count in one scenario, but not the other?

This example suggests that the non-monotonicity effect persists even if we control for context-dependency by explicitly providing a question that restricts the hDP's domain. Thus, while generalization (12) correctly predicts (18) to be non-trivial, it still fails to derive the non-monotonicity effect. At this point, one could claim that the domain of a hDP restricted by a question contains just the elements of the Hamblin set and possibly their negations, while the other partial answers are disregarded. Since $a \lor b$ is not a Hamblin answer in (18), this would account for the effect in the $a$/$b$ scenario. At first sight, this hypothesis seems like a non-starter since it predicts (18) to be false in the $a \lor b$/$a \lor b$ scenario as well. But the following variant is worth taking seriously:

(20) **hDP Generalization 2 (to be revised)**

hDPs of type $\langle(s, t), t \rangle$ contain a domain-restriction variable whose value is the Hamblin set of a question $Q$. Their domain is restricted to propositions that are either in $Q$ or in the Hamblin set of a contextually salient subquestion of $Q$.

(21) For current purposes, a question $Q$ is a subquestion of another question $Q'$ iff any
The intuition behind (20) is that the non-monotonicity effect can be obviated by making certain subquestions salient, as shown in (22). Context (22a) establishes the subquestion which contains the teams in the final will come from. Since (22b) is true in the scenario, the proposition \([a \text{ European team will be in the final}]\) seems to be in the domain of the indefinite hDP. This is surprising since, given general world knowledge, this proposition is equivalent to a disjunction of several Hamblin answers to the question \([who \text{ will be in the final}]\). If the question introduced by the modifier were all that mattered, we would therefore expect a non-monotonicity effect in both (22a) and (19b), for the same reason. But since (22a) introduces a subquestion that has \([a \text{ European team will be in the final}]\) in its Hamblin set, the effect does not arise.

\[(22)\]

a. **SCENARIO:** Peter and Maria are discussing the upcoming World Cup with their friend Fritz. They have a long-standing disagreement about the question which continent(s) the teams in the final will come from. Peter believes that France will make the final and Maria believes that Germany will make it. But Fritz believes that both finalists will be South American teams like Brazil or Uruguay.

b. **Zur Frage, wer ins WM-Finale kommt, glaubt der Peter** to the question who into the World Cup final comes believes the Peter etwas, das auch die Maria glaubt. something REL also the Maria believes ‘As for the question who will make it to the World Cup final, Peter believes something Maria also believes.’

This observation suggests the following explanation of the contrast in (19): In the \(a \lor b / a \lor b\) scenario, the proposition \(a \lor b\) is explicitly mentioned, which makes the subquestion \(Q' = \{\text{whether at least one of Ada and Brit will come}\}\) salient. The Hamblin set of this subquestion clearly contains \(a \lor b\). In contrast, nothing in the \(a/b\) scenario \((19b)\) makes \(Q'\) salient.

One argument against the approach in (20) involves ‘asymmetrical’ scenarios in which one of the two attitude subjects believes a disjunction, while the other believes one of the disjuncts. An example is given in (23). If the judgment in the \(a \lor b / a \lor b\) scenario were due to the fact that a disjunctive partial answer is mentioned, we would expect an equally clear-cut judgment for the \(a \lor b / a\) scenario. However, this is not borne out: While restricted higher-order existentials are sometimes accepted in scenarios like (23), judgments vary a lot and some speakers I consulted report being unsure about the judgment. Further work on examples like (23) is needed to determine the source of the variation.

\[(23)\]

a \lor b / a **SCENARIO:** Three people were invited: Ada, Brit and Carl. Peter believes at least one of Ada and Brit will come. Maria believes that Ada will definitely come. They have no other relevant beliefs. (18) %not true

Instead of pursuing an explanation based on the contextual salience of a disjunction, I will therefore try to describe the contrast in (19) in semantic terms. On a semantic approach, the

9The relativization to general world knowledge, which is not included in some otherwise similar definitions in the literature (e.g. Groenendijk and Stokhof 1984: 220, (7)), is arguably needed to account for the World Cup example (22) since, say, \([\text{France will be in the final}]\) does not logically entail \([\text{a European country will be in the final}]\).
a/b scenario shows us that the restrictor and the nuclear scope of the hDP are each narrowed down by a mechanism that is sensitive to logical strength. That is, if Peter has a belief $p$ that partially answers the question provided by the modifier – or one of its salient subquestions – then his logically weaker beliefs that answer the same question are disregarded. A first precise statement of this generalization is given in (24): (24a) defines an operator $\text{MINPA}_{\subseteq}$ (‘minimal partial answers with respect to logical strength’) that applies to a set $\mathcal{Q}$ of questions and a predicate $P$ of propositions and returns a predicate true of only those propositions satisfying $P$ that i) partially answer a question $Q$ in $\mathcal{Q}$ and ii) are minimal w.r.t. $\subseteq$ among the propositions in $P$ that partially answer $Q$. (24b) then says that both arguments of the indefinite determiner are obligatorily restricted by $\text{MINPA}_{\subseteq}$. The relevant set $\mathcal{J}_{\text{w},c}$ of questions includes the contextually provided question plus any subquestions that were explicitly raised in the preceding discourse.

(24) **HDP Generalization 3 (to be revised)**

a. For $P \in D_{\langle s, \langle s, t, t \rangle \rangle}$ and $\mathcal{Q} \in D_{\langle s, \langle s, t, t \rangle \rangle}$:

$$\text{MINPA}_{\subseteq}(\mathcal{Q})(P) = \lambda w. \lambda p. P(w)(p) \land \exists Q \in \mathcal{Q}[p \in \text{PA}(Q) \land \neg \exists p'[p' \subseteq p \land p \neq p'] \land P(w)(p') \land p' \notin \text{PA}(Q)]$$

b. With respect to a context $c$ and assign context $g$, a restricted higher-order existential with the determiner $\exists_{(s,t)}$, the restrictor predicate $P$, the nuclear scope $P'$ and the domain-restricting question $C$ is interpreted as

$$\lambda w. [\exists_{(s,t)}]_g(w)(\text{MINPA}_{\subseteq}(\mathcal{J}_{\text{w},c})([P^g]_c(w))) (\text{MINPA}_{\subseteq}(\mathcal{J}_{\text{w},c})([P^g]_c(w))),$$

where $\mathcal{J}_{\text{w},c}$ is the set containing $[C]_g^c(w)$ and those of its subquestions that were raised in the preceding discourse in $c$.

How does this account for the data pattern? Let $Q$ be the Hamblin set $\{a, b, c\}$ as above and let $c$ be a context in which no subquestions were raised. According to (24), (18) is true in the $a \lor b$ scenario w.r.t. $c$ if the sets in (25a-i) and (25a-ii) have a nonempty intersection. Since $a \lor b$ is both Peter’s and Maria’s strongest partial answer to $Q$ in the scenario, this condition is satisfied. In contrast, in the $a/b$ scenario, $a \lor b$ is eliminated both from the restrictor and from the nuclear scope by $\text{MINPA}_{\subseteq}$ since Peter and Maria each believe a logically stronger partial answer. (18) is then predicted to be false.

(25)
a. $a \lor b$ scenario:

(i) $\text{MINPA}_{\subseteq}(\{Q\})([[[1, \langle s, t \rangle)] (\text{Peter } t_{1, (s, t)} \text{ glaubt})]_c]^c)(w_0) = \{a \lor b\}

(ii) $\text{MINPA}_{\subseteq}(\{Q\})([[[1, \langle s, t \rangle)] (\text{Maria } t_{1, (s, t)} \text{ glaubt})]_c]^c)(w_0) = \{a \lor b\}

b. $a/b$ scenario:

(i) $\text{MINPA}_{\subseteq}(\{Q\})([[[1, \langle s, t \rangle)] (\text{Peter } t_{1, (s, t)} \text{ glaubt})]_c]^c)(w_0) = \{a\}

(ii) $\text{MINPA}_{\subseteq}(\{Q\})([[[1, \langle s, t \rangle)] (\text{Maria } t_{1, (s, t)} \text{ glaubt})]_c]^c)(w_0) = \{b\}$

In the World Cup scenario (22), the two questions $Q = [[\text{which teams will be in the final}]]$ and $Q' = [[\text{which continent(s) the teams in the final come from}]]$ are both relevant. Let us say that the proposition that there will be a European team in the final partially answers $Q'$ and note that $\text{MINPA}_{\subseteq}(\mathcal{Q})(P)$ is the property of being a proposition that, for some question in $\mathcal{Q}$, is $\subseteq$-minimal among the propositions in $P$ that partially answer $\mathcal{Q}$. Thus, after $\text{MINPA}_{\subseteq}$ applies, the restricted set of Peter’s beliefs and the restricted set of Maria’s beliefs will both contain the proposition $[[\text{there will be a European team in the final}]]$ because neither of the two has a stronger partial answer to $Q'$, although their partial answers to $Q$ are stronger.

(26) $\text{MINPA}_{\subseteq}(\{Q, Q'\})([[[1, \langle s, t \rangle)] (\text{Peter } t_{1, (s, t)} \text{ glaubt})]_c]^c)(w_0)$
Finally, what about the $a \lor b/a$ scenario (23)? Here the predictions of (24) seem a bit too clear-cut: If the adverbial contributes the question $Q = [\text{who will come to dinner}]$ with the restricted Hamblin set $\{a, b, c\}$ and no other subquestions of $Q$ are fed to Minpa$_\subseteq$, we end up with two singleton sets containing Peter’s and Maria’s strongest answers to $Q - \{a \lor b\}$ for Peter and $\{a\}$ for Maria. Since these sets are disjoint, (18) comes out as false in the scenario. One potential way of making sense of the unclear judgments might be that, since $a \lor b$ is explicitly mentioned in the scenario, a hearer could, but does not have to, accommodate a context in which the polar question whether $a \lor b$ was raised. In such a context, Minpa$_\subseteq$ will return the set $\{a, a \lor b\}$ when applied to Maria’s beliefs, so the two sets intersected by $\exists_{(s,t)}$ are no longer disjoint.

Let me summarize the results of the last two sections. We started with the observation that higher-order identity statements are evaluated relative to a restricted domain of propositions that depends on a contextually provided question. This seems to solve our initial puzzle – why restricted higher-order existentials have non-trivial truth conditions – but on closer inspection, it is not enough to derive the non-monotonicity effect. I therefore proposed that each of the sets of propositions intersected by the indefinite determiner should first be narrowed down to those of its elements that are the subject’s strongest answer to a subquestion in a certain set. This set contains the contextually given question as well as any subquestions explicitly raised in the context. In the next section, I will discuss two further refinements of this generalization.

5. Refining the descriptive generalization

5.1. Canonical subquestions

In the $a \land b/b \land c$ scenario (19c), our running example (18) is judged true, intuitively because both attitude subjects believe $b = [\text{Brit will come}]$. But as in the $a/b$ scenario, Peter’s strongest answer to the pertinent question, $a \land b$, and Maria’s strongest answer, $b \land c$, are logically independent. The sets of propositions returned by Minpa$_\subseteq$ are therefore disjoint (28) and our current generalization (24) predicts (18) to be false despite the shared belief.

\begin{align*}
(27) & \quad a \land b/b \land c \text{ SCENARIO} \\
& \text{a. Minpa}_\subseteq(\{Q\})([[[1, (s,t)], t_1[1,(s,t)] glaubt]]^c)_{(w_0)} = \{a \land b\} \\
& \text{b. Minpa}_\subseteq(\{Q\})([[[1, (s,t)], t_1[1,(s,t)] glaubt]]^c)_{(w_0)} = \{b \land c\}
\end{align*}

Since the logical relations between Peter’s and Maria’s shared beliefs and their strongest relevant beliefs are the same in the $a/b$ and $a \land b/b \land c$ scenarios, we need to go beyond such relations to account for the lack of a non-monotonicity effect in the $a \land b/b \land c$ scenario. I submit that, while the basic idea of comparing the attitude subjects’ strongest answers to certain subquestions of a $wh$-question $Q$ is correct, we should consider a larger set of subquestions that includes at least all those subquestions derivable by restricting the domains of the $wh$-phrases in $Q$. Given a Hamblin semantics, this is easy to define:

\begin{align*}
(28) & \quad \text{The canonical subquestions} \text{ of a question extension } Q \text{ are the non-empty subsets of the Hamblin set of } Q.
\end{align*}

The set of subquestions passed to the Minpa$_\subseteq$ operator will contain the question $Q$ contributed
by the modifier and those subquestions explicitly raised in the discourse, but in addition, it will be closed under canonical subquestions. Thus, if the question \( \{a, b, c\} \) (‘Who among Ada, Brit and Carl will come?’) is in this set, so are \( \{a, b\} \) (‘Who among Ada and Brit will come?’) and \( \{a\} \). I take the latter set to correspond to the polar question ‘Will Ada come?’, contra Hamblin’s (1973) assumption that the extension of a polar question also contains the negative answer.\(^{10}\) The restricted set that we get by applying \( \text{MINPA}_\subseteq \) to a given subject’s beliefs will then also contain those propositions that are the subject’s strongest partial answer to at least one canonical subquestion. This principle is summarized in (29):

\[
(29) \quad \text{Given a question } Q \text{ and a world } w, \text{ each argument } P \text{ of the indefinite determiner in a hDP restricted by } Q, \text{ when evaluated in } w, \text{ is narrowed down to } \text{MINPA}_\subseteq(\mathcal{J}_{Q,w,c})(P)(w),
\]

where \( \mathcal{J}_{Q,w,c} \) is the smallest set that contains \( Q(w) \) and the subquestions of \( Q(w) \) raised in the preceding discourse context in \( c \) and is closed under canonical subquestions.

How does this account for the \( a \lor b / a \lor b \) and \( a \land b / b \land c \) scenarios? The predictions are summarized in Figures 1 and 2. For each attitude subject \( x \), every canonical subquestion \( Q \) that \( x \) can partially answer is connected by dotted arrows to the strongest proposition \( x \) believes that partially answers \( Q \) – i.e. the answer that will remain after \( \text{MINPA}_\subseteq \) has applied. For the \( a \land b / b \land c \) scenario, since \( \{b\} \) is a canonical subquestion and \( b \) is both Peter’s and Maria’s

\(^{10}\)To my knowledge, the main empirical reason to include negative answers in the Hamblin sets of polar questions is that polar questions embedded under predicates like know lack the ‘weakly exhaustive’ reading observed for wh-questions, which is insensitive to the subject’s epistemic state w.r.t. negative answers. However, since the existence of this reading is disputed anyway (see e.g. Cremers and Chemla 2016), I am not fully convinced by this argument.
strongest partial answer to that question, $b$ will still be contained in both arguments of the indefinite determiner after we apply $\text{MINPA}_{\subseteq}$. Why is the $a/b$ scenario different? Since $\{a \lor b\}$ is not a canonical subquestion of $\{a, b, c\}$, there is no canonical subquestion that $a \lor b$ is Peter’s strongest partial answer to: While Peter believes an answer to the question $\{a\}$ (‘Will Ada come?’) that entails $a \lor b$, $a \lor b$ is not itself a partial answer to that question. The canonical subquestion $\{a, b\}$ is partially answered by $a \lor b$, but in this case $a \lor b$ is excluded by $\text{MINPA}_{\subseteq}$ since Peter also believes the stronger answer $a$.

The proposal also accounts for scenarios like (30) that involve both disjunctive and non-disjunctive beliefs. Since $a \lor b$ is both subjects’ strongest answer to the canonical subquestion $\{a, b\}$, the restricted sets of beliefs will have a non-empty intersection even though they believe incompatible answers to the canonical subquestion $\{c\}$, which also makes their respective strongest answers to $\{a, b, c\}$ incompatible (see Figure 3).

\[(a \lor b) \land c / (a \lor b) \land \neg c\]

**SCENARIO**: Three people were invited: Ada, Brit and Carl. Peter believes at least one of Ada and Brit will come and Carl won’t come. Maria believes at least one of Ada and Brit will come and Carl will come. They have no other relevant beliefs.

In sum, we have seen that sentences involving hDPs are sensitive to the internal structure of question denotations.\(^{11}\) Note that compared to hDP generalization 2, which also made crucial reference to the Hamblin set, the present approach is more permissive: On our current generalization, the output of the $\text{MINPA}_{\subseteq}$ operator is a property that may still be true of disjunctive answers, in case there is some canonical subquestion $Q$ such that the disjunction is the subject’s strongest belief that partially answers $Q$.

5.2. Downward-monotonic predicates

We now have a better understanding of the effects of context on restricted higher-order existentials with $\text{believe}$. But does this approach generalize to other attitude predicates? Recall

\(^{11}\)Sometimes, we need a more fine-grained notion of ‘canonical subquestion’ that is not based on standard Hamblin sets. For instance, $\llbracket\text{who owns the books}\rrbracket$ should arguably have $\llbracket\text{whether Anna owns book 1}, \text{whether Brit owns book 2}\rrbracket$ etc. among its canonical subquestions. The relevance of plurals for the part-whole structure of questions is independently motivated by Beck and Sharvit (2002), who show that a more permissive notion of subquestion is needed to account for certain cases of quantificational variability effects.
that for believe, we predict that a proposition may be ‘disregarded’ if the subject also believes a logically stronger proposition that partially answers the same relevant subquestions. This reference to logical strength might become problematic when we consider downward-monotonic predicates. A relatively clear case of a downward-monotonic attitude verb in German is ausschließen ‘rule out’, which can also appear in restricted higher-order existentials (32). I will assume the simple possible-worlds semantics in (31) for this verb.

\[(\text{ausschließen}) = \lambda w.\lambda x_e.\lambda x_e.\forall w'[w' \in \text{DOX}(x) \rightarrow p(w') = 0]\]

(32) Zur Frage, wer am Tatort war, schließt der Peter etwas aus, das

do the question who at the crime scene was rules the Peter something out REL
die Maria auch ausschließt.
the Maria also out-rules
‘Peter rules something out that Maria also rules out.’

The fact that (32) can be judged false in an a/b scenario like (33)\(^\text{12}\) exemplifies the non-monotonicity effect: If Peter rules out the possibility that A was at the crime scene and Maria rules out the possibility that B was there, then presumably a scenario in which A and B were both at the crime scene is ruled out by both of them. If the quantification over propositions in (32) were unrestricted, we would therefore predict (32) to be true in the scenario.

(33) **Scenario:** Peter and Maria are investigating a crime with suspects A, B and C. Peter has come to the conclusion that A cannot have been at the crime scene. Maria thinks B cannot have been there. These are their only findings so far. (32) \%false

Our current generalization does not predict a non-monotonicity effect here. The wh-question in (32) has a canonical subquestion \(\{a, b\}\), where \(a = [A \text{ was at the crime scene}]\) and \(b = [B \text{ was at the crime scene}]\). Given the semantics in (31), the partial answers to \(\{a, b\}\) that Peter rules out in scenario (33) include \(a, a \land b\) and \(a \land \neg b\). The partial answers Maria rules out include \(b, a \land b\) and \(\neg a \land b\). Clearly, the strongest partial answer ruled out by both of them is \(a \land b\). But since generalization (24) is sensitive to logical strength, rather than the monotonicity properties of the predicates involved, ‘strong’ partial answers like \(a \land b\) are never disregarded. If we assume the judgment in (33) and take it as indicative of a non-monotonicity effect (but see Footnote 12), we want a generalization that removes such ‘strong’ partial answers if the predicate is downward-monotonic: If you believe \(a\), then \(a \lor b\) should be disregarded because believing \(a\) entails believing \(a \lor b\). But if you rule out \(a\), then \(a \land b\) should be disregarded because ruling out \(a\) entails ruling out \(a \land b\). This is implemented by the operator \(\text{MINPA}\) in (34), a revised version of \(\text{MINPA}_\text{C}\). Instead of directly comparing the different partial answers to a given subquestion with respect to logical strength, \(\text{MINPA}\) compares the propositions obtained by applying the predicate \(P\) to them. If \(P\) is downward-monotonic, the resulting property will be true of those propositions that are the weakest partial answer to some relevant subquestion that

\(^{12}\text{This judgment is not universally shared (Magdalena Kaufmann and Clemens Steiner-Mayr, p.c.), while the judgment reported for analogous a/b scenarios with believe, like (19b), is shared by all speakers I have asked. However, the varying judgments for (32) are still problematic for generalization (24) above, which predicts it to be unequivocally true in (33). Since we observed in Section 3 that such judgments generally depend on which subquestions are accommodated, the variation might show that subquestions asking whether a given conjunction of Hamblin answers is true are easier to accommodate than the analogous subquestions involving disjunction. In any case, further work is needed to test my empirical claim in the text.}\)
satisfies \( P \). If \( P \) is upward-monotonic, the predictions of our earlier definition do not change.

\[
\text{(34)} \quad \text{For } P \in D_{(s,t)}^{(s,t)} \text{ and } Q \in D_{(s,t)}^{(s,t)}: \\
\MINPA(Q)(P) = \lambda w. \lambda p. P(w)(p) \land \exists Q \in Q[p \in \PA(Q) \land \neg \exists p'[P(w)(p') \land p \neq p'] \subseteq (\lambda w'. P(w')(p')])
\]

The final version of our descriptive generalization, which uses \( \MINPA \) and includes canonical subquestions in addition to the subquestions mentioned in the discourse, is given in (35).

\[
\text{(35)} \quad \text{hDP Generalization 4} \\
\text{With respect to a context } c \text{ and assignment } g, \text{ a restricted higher-order existential with the determiner } \exists_{(s,t)}, \text{ the restrictor predicate } P, \text{ the nuclear scope } P' \text{ and the domain-restricting question } C \text{ is interpreted as } \\
\lambda w. \exists_{(s,t)}(w)(\MINPA(\mathcal{S}_{w,g,c})([P]^{g,c})(w))(\MINPA(\mathcal{S}_{w,g,c})([P']^{g,c})(w)). \\
\mathcal{S}_{w,g,c} \text{ is the smallest set that contains } C^{g,c}(w) \text{ and those of its subquestions that were raised in the preceding discourse in } c \text{ and is closed under canonical subquestions.}
\]

At this point one might wonder whether the \( \MINPA \) operator is also at work in higher-order identity statements like (16) above. For the cases discussed in this paper, an analysis along the lines of (36), which requires the output of \( \MINPA \) to be the same for each of the sets of propositions that are being compared, would give the same results as our original semantics.

\[
\text{(36)} \quad [[\text{dasselbe } C_{(i,(s,t)),t}]] \text{ glauben}]^{g,c} = \lambda w. \lambda x. \exists y_{(s,t),t}. \forall y_c[y \leq x] \\
\rightarrow \MINPA(\mathcal{S}_{w,g,c})(\lambda w. \lambda p_{(s,t),t}. [[\text{glauben}]](w)(p)(y))(w) = S
\]

where \( \mathcal{S}_{w,g,c} \) is the smallest set that contains \( C^{g,c}(w) \) and those of its subquestions that were raised in the preceding discourse context in \( c \) and is closed under canonical subquestions.

The data from Section 2 is therefore compatible with the idea that all cases of DP quantification over propositions involve \( \MINPA \). But to turn this into a testable hypothesis that also makes predictions about other determiners, one would have to specify the role of the \( \MINPA \) operator in semantic composition. While this is beyond the scope of the present paper, the next section briefly discusses one issue that further constrains the analytical options available.

6. Conditions on the non-monotonicity effect

We now have a descriptive generalization that predicts under which conditions a given restricted higher-order existential gives rise to a non-monotonicity effect. But one question we have not addressed so far is whether this effect is specific to hDPs or whether it reflects a more general constraint on DP quantification. Here, I will first provide an argument for the latter option and then discuss a possible formulation of the constraint.

6.1. Informational object nouns and the non-monotonicity effect

So far, one might think that the non-monotonicity effect is limited to DPs that quantify over entities of type \( (s,t) \) or other functional types (as I suggested in earlier work; Haslinger 2019). But on closer inspection, it is not obvious that semantic type predicts when we find the effect. One counterargument comes from the ‘informational object nouns’ studied by Sutton and Filip (2019), which arguably do not express predicates of propositions. An example with the Ger-
man noun *Information* is given in (37). The predicate *Information haben* ‘have information’ appears to be upward-monotonic with respect to the content of the information: If you have the information that it is raining heavily, you also have the information that it is raining. However, if Maria just learned that Ada will come to dinner and Peter knows that Bea will come, (37) is not necessarily true – an instance of the non-monotonicity effect.13

(37) *Zur Frage, wer heute kommt, hat die Maria (etwas) Information, die der Peter auch hat.*

‘As for the question who will come today, Maria has some information Peter also has.’

Yet, a test due to Elliott (2017) (see also Haslinger 2019: ch. 2) shows that the DP in (37) does not directly range over propositions: Certain attitude verbs, such as *denken* ‘think’ (in the sense of ‘believe’), can combine with clausal complements and with hDPs, but not with DPs ranging over individuals. Since such predicates do not generally disallow DP objects, the contrast must be semantic and plausibly reflects a type distinction. Crucially, DPs with head nouns like *Information* behave like ordinary DPs ranging over individuals: they are odd in the object position of predicates like *denken*. This suggests that such DPs quantify over individuals or states associated with propositional content (but see Sutton and Filip 2019 for a more nuanced view).

6.2. A general constraint on DP quantification?

What does this mean for the analysis of the non-monotonicity effect? First, it raises a problem for any approach assuming a special meaning of the indefinite determiner for hDPs, as I did in Haslinger (2019) and my SuB presentation. The idea there was that the determiner meaning applies M\text{IN}PA, or some similar operation, to both of the predicates of propositions it combines with; the resulting predicates are intersected. This entails giving up the assumption that the semantics of determiners is given by a uniform cross-categorial schema. It is also counterintuitive in light of the fact that all determiners found in German hDPs can also be used to quantify over individuals: If there was a determiner meaning specific to hDPs, this formal correspondence would have the status of a coincidence. Examples like (37) strengthen this point: Given Elliott’s diagnostic, *Information* is naturally analyzed as a predicate of abstract entities that have propositional content, but are not themselves propositions. It would then be unclear why the ‘ordinary’ indefinite determiner, which does not give rise to the non-monotonicity effect, cannot apply to informational object nouns.

An obvious alternative would be to build M\text{IN}PA into a separate functional element that shows up with predicates of propositions (or other entities with propositional content), but is semantically incompatible with predicates of concrete individuals since concrete individuals do not relate to questions in the required way. The plausibility of this kind of approach depends on the cross-linguistic situation – we would expect some languages to have overt functional elements (e.g. a classifier) whose presence correlates with the non-monotonicity effect. In the absence of

\[13\]The noun *Information* has a count and a mass reading. The fact that (37) involves *etwas* ‘some/a little’, which requires a mass NP, shows that the non-monotonicity effect is not due to the individuation mechanism Sutton and Filip (2019) propose for *count* DPs involving informational object nouns.
cross-linguistic data on the effect, I want to merely discuss a general issue raised by analyses of this kind.

For concreteness, consider the operator RESTRICT\textsubscript{i} in (38), which modifies a predicate of propositions by applying MINPA to this predicate and a set of questions determined by its index. (RESTRICT\textsubscript{i} could be defined cross-categorially so that it also applies to ‘pieces of information’; I omit this for reasons of space.) If insertion of RESTRICT\textsubscript{i} is optional, which predictions do we make?

\[(38) \quad \text{[RESTRICT}_{i}\text{]}^\mathcal{E} = \lambda w. \lambda P_{g_i,((s, t), t)} \cdot \text{MINPA}(\mathcal{S}_{\mathcal{E}}(g_i, ((s, t), t), \mathcal{E})(P))\]

where \(\mathcal{S}_{\mathcal{E}}\) is the smallest set that contains \(Q\) and all the subquestions of \(Q\) that were mentioned in the discourse in \(\mathcal{E}\) and is closed under canonical subquestions.

If both arguments of the determiner are modified by RESTRICT\textsubscript{i}, as in (39), the truth conditions are as predicted by our hDP generalization 4 in (35). Modifying only one argument with RESTRICT\textsubscript{i} would also get most cases right, but makes different predictions for ‘asymmetrical’ scenarios like the \(a \lor b / a\) scenario in (23); however, since I do not fully understand the conditions under which restricted higher-order existentials are accepted in such scenarios, I cannot rule out the existence of a reading on which only one argument of \(\exists (s, t)\) is restricted. The real problem is that, if RESTRICT\textsubscript{i} is completely optional, we could have an LF which does not contain it and therefore fails to trigger the monotonicity effect.

\[(39) \quad [\exists (s, t) \quad \text{[RESTRICT}_{2}\text{]} _{-was} [[((s, t), t) \cdot (1, (s, t)) \cdot \text{'Peter'} \cdot [t_{(1, (s, t))} \cdot \text{glaubt}]]]]\]

While we could make RESTRICT\textsubscript{i} syntactically obligatory, this would give rise to the same problems as an analysis based on two distinct determiner meanings. Among other issues, the syntax would have to be sensitive to the distinction between informational object nouns and other predicates of basic-type entities. This invites the speculation that insertion of RESTRICT\textsubscript{i} is forced by a semantic (or possibly pragmatic) constraint on DP quantification that applies cross-categorially, but does not have noticeable effects in the case of quantification over concrete individuals. This constraint would have to be such that it is never met if the determiner combines with predicates of propositions that are both upward-monotonic or both downward-monotonic, while for ordinary predicates of concrete individuals, it would trivially be met.

To illustrate what this constraint could look like, let us return to the puzzle from Section 2: An analysis based on unrestricted quantification over propositions predicts (40a) to be true whenever John has some belief and Mary has some belief. Similarly, if there are no further restrictions on the propositional content of ‘pieces of information’, upward-monotonicity predicts that (40b) is true whenever John has some information and Mary has some information.\textsuperscript{14}

In both cases, it follows from the semantics of the predicates related by the determiner that, whenever both predicates have non-empty extensions, their intersection will be non-empty.

\[(40) \quad \text{a. John believes something Mary (also) believes.}\]
\[\text{b. John has some information Mary (also) has.}\]

\textsuperscript{14}The assumption that have information is upward-monotonic with respect to the propositional content of the information has the counterintuitive consequence that one can ‘have information’ whose content is trivial. I leave the question to what extent this is a problem to future work.
This suggests the descriptive claim that indefinite DPs are only felicitous if this type of entailment does not hold. Taken literally, this is too strong since it would exclude all cases of entailment relations between the two arguments of the determiner (cf. Some linguists are good linguists). However, the following weaker formulation seems to make adequate predictions:

(41) If there is no entailment relation between the restrictor $P$ and the nuclear scope $Q$, then $\lambda w. \exists x. P(w)(x) \land \lambda w. \exists x. Q(w)(x)$ do not jointly entail $\lambda w. \exists x. [P(w)(x) \land Q(w)(x)]$.

The idea is that if we interpret (40a) and (40b) with an upward-monotonic predicate meaning and no domain restriction, (41) is violated unless we apply a domain-restriction mechanism which then gives rise to the non-monotonicity effect. In contrast, cases like (42a) satisfy (41) regardless of how domain restriction works. A more interesting prediction involves predicates of abstract mass individuals that are ‘monotonic’ with respect to the part-of relation. For instance, if you have read a piece of text, it arguably follows that you have read its parts, to the extent that these are also text. One might therefore expect to find a counterpart of the non-monotonicity effect in (42b). (41) predicts – correctly, I suspect – that this is not the case, since two pieces of text do not necessarily have a common part while two propositions (and, if my assumption is correct, two pieces of information) always have a common entailment.

(42) a. Some linguists are asleep.
    b. John read some text that Mary had (also) read.

It is therefore worth investigating whether the constraint in (41) makes plausible predictions in other situations – for instance in cases where the monotonicity properties of the restrictor and the nuclear scope are distinct – and if so, how it could be implemented. While (41) could be added to the cross-categorial determiner meaning as a presupposition, it should arguably follow from some deeper, possibly pragmatic principle that also applies to other determiners.  

7. Conclusion

This paper investigated the truth conditions of sentences with ‘higher-order DPs’ (hDPs) quantifying over propositions. The main focus was on the ‘non-monotonicity effect’: the observation that, given the monotonicity properties we standardly take attitude verbs to have, certain propositions are unexpectedly missing from the domains of hDPs selected by such verbs. According to the descriptive generalization I proposed, hDPs are sensitive to a contextually given question meaning, which provides the ‘structure’ needed to determine the domain of propositions that the hDP quantifies over. In particular, this domain depends on the Hamblin set of the question, rather than just the set of propositions that partially answer it or are relevant to it. If true, this is relevant for the choice between theories of question semantics, since e.g. partition semantics (Groenendijk and Stokhof, 1984) provides no way of deriving Hamblin sets.

While I did not provide an analysis of hDPs that explains the monotonicity effect, the generalization is compatible with various ways of building the effect into the DP meaning, which would remove the need for a non-monotonic verb semantics (cf. Zimmermann 2006). Further, I argued that the effect is not tied to higher-type quantification and proposed a tentative generalization about the class of predicates that give rise to it. If this generalization holds up, the lexical monotonicity properties of different predicates actually play a role in predicting when

15Note that the effect cannot be due to a Quantity implicature, even if $\lambda w. \exists x. [P(w)(x) \land \exists x. Q(w)(x)]$ is assumed to be an alternative of $\lambda w. \exists x. [P(w)(x) \land Q(w)(x)]$: If (41) is violated, the two putative alternatives are equivalent.
the effect occurs. Needless to say, many empirical questions where left open here. The need for a cross-linguistic study of the non-monotonicity effect, which could decide between different implementations, was already discussed in Section 6. Another open question is whether the effect is found with asymmetric determiners like every. Finally, the effect should be related more explicitly to the work of Sutton and Filip (2019) on ‘individuation schemas’ – a contextual parameter that influences how we count abstract entities with propositional content.

References


Cumulative readings of modified numerals: A plural projection approach

Nina HASLINGER — Georg-August-Universität Göttingen
Viola SCHMITT — Karl-Franzens-Universität Graz

Abstract. This paper addresses cumulative readings of modified-numeral DPs (MNs) like exactly two boys. Based on new German data, we argue that MNs are interpreted in situ in cumulative sentences, while the maximality condition contributed by the numeral modifier can take wider scope. We present an analysis that combines the Plural Projection system (Schmitt, 2019 a.o.), a surface-compositional approach to cumulativity, with a two-dimensional semantics for the numeral modifiers (Krifka, 1999 a.o.) and derives widest scope for the maximality condition. We then discuss ‘non-maximal’ readings of MNs (Buccola and Spector, 2016). We show that the availability of such readings depends on the syntactic positions of the MNs, which supports the idea that they are interpreted in situ, and sketch a way of deriving this fact.

Keywords: cumulativity, modified numerals, plurality, scope, plural projection.

1. Introduction

1.1. Background

Like other sentences with multiple plural expressions, sentences with plural DPs headed by modified numerals – we call such DPs MNs – can exhibit cumulative truth-conditions (Scha, 1981 a.o.): (1a) is true in the ‘cumulative’ scenario (1b), where exactly two students read books, but neither read exactly two books. (Throughout, Ada, Bea and Carl will be the students.)

(1) a. Exactly two students read exactly two books.

As many have noted (e.g., Krifka, 1999; Landman, 2000; Brasoveanu, 2013; Buccola and Spector, 2016), the behavior of MNs in cumulative sentences raises a problem for the semantic analysis of such expressions. First, the cumulative reading of (1a) is clearly incompatible with the traditional generalized quantifier treatment of MNs in (2) (Barwise and Cooper, 1981).

(2) \[ [\text{exactly two NP}] = \lambda P(e,t).|\text{NP}| \cap P = 2 \]

But if we assume that MNs quantify existentially over pluralities as in (3) – following the intuition that cumulativity is a hallmark of plurality – we run into what is known as ‘van Benthem’s problem’ (van Benthem, 1986) for MNs like exactly two that impose a maximality condition (i.e., an upper bound). Since (3) only requires the existence of a plurality of a certain size, it falsely predicts (4) to be true in a scenario where three students failed the exam.

(3) \[ [\text{exactly two NP}]: \lambda P(e,t).\exists x_e [x \text{ is an } \#\text{-plurality } \land |x| = 2 \land P(x)] \]

(4) Exactly two students failed the exam.

The maximality condition is also observable in cumulative sentences like (1a): (1a) is false in all the scenarios in (5). We therefore cannot assume that cumulative sentences require special,
‘non-maximal’ denotations for MNs along the lines of (3). Instead, we need a semantics for MN that encodes the maximality condition both in distributive and in cumulative sentences.


1.2. Claims

Landman (2000) argues that in cumulative sentences, the maximality condition is ‘global’, i.e., it has scope over all the plurals in the sentence. For (1a), this means that we cannot let each MN introduce a separate maximality condition as in (6a), while interpreting one MN in the scope of the other as in (6b). This would falsely predict (1a) to be true in scenario (5a) (cf. (6c)).

(6) a. \([\text{exactly two } \text{NP}] = \lambda P(e,f). \exists x [x \text{ is an } \text{NP}-\text{plurality } \land |x| = 2 \land P(x) \land \neg \exists y [y \text{ is an } \text{NP}-\text{plurality } \land x < y \land P(y)]]\)
b. [exactly two students] [1 [exactly two books] [2 [t₁ **read t₂]]]  
c. ‘There is a plurality \(x\) of two students that cumulatively read exactly two books and there is no plurality \(x' > x\) of students that cumulatively read exactly two books.’

So, scope asymmetries between the MNs appear to be disregarded for the purposes of their maximality conditions. This seems to fit well with the traditional ‘scopeless’ conception of cumulative readings (see Scha, 1981; Sher, 1990; Sternefeld, 1998): The basic idea is that a cumulative reading involving \(n\) plurals always involves a cumulation operation that applies to an \(n\)-ary relation. In (1a), for instance, a ‘cumulative version’ **[read]** of the binary relation **[read]** is derived by simultaneously summing up readers and objects they read (i.e., if A read book 1, and B read book 2, then **[read]** = \(\{\langle a, b1 \rangle, \langle b, b2 \rangle, \langle a + b, b1 + b2 \rangle\}\)). On this approach, if the cumulative relation is not lexicalized, as in (7), the syntax has to derive an LF constituent denoting a suitable relation, e.g. the relation \(\lambda x. \lambda y. y \text{ wanted to marry } x\) for (7).

(7) The two women wanted to marry the two men. Beck and Sauerland (2000)

Yet, we will present two phenomena that strongly suggest that syntactic asymmetries matter for the interpretation of MNs and therefore should not be ‘flattened out’ in the way just sketched. Based on this, we will provide a novel treatment of MNs.

Point 1: We first present data showing that the ‘plural component’ of MNs must be interpreted in situ. This leaves us with a ‘split-scope’ puzzle: The plural component of a MN must be severed from its maximality condition, since the latter must be able to have widest scope. We account for this by combining the plural projection mechanism (Haslinger and Schmitt, 2018; Schmitt, 2019) – an analysis of cumulativity in which all plurals are interpreted in situ – with a two-dimensional semantics that ensures that the maximality condition is ‘read off’ at the root level and therefore gets widest scope, following Krifka (1999), Landman (2000) and Brasoveanu (2013). The system will derive cumulative readings in a surface-compositional manner. However, their derivation will involve two separate meaning components that basically specify pluralities ‘of the right size’ and pluralities that are ‘too big’, respectively. Since the two levels are combined in the truth definition, maximality will come out as a global condition.

\(^2\)A cumulative scenario is e.g. one where woman 1 wanted to marry man 1 and woman 2 wanted to marry man 2.
Point 2: Our second empirical observation fits in well with our general goal of maintaining syntactic asymmetries between MNs in cumulative sentences: We show that the maximality condition of MNs is itself affected by such syntactic asymmetries. MNs permit a non-maximal reading (see also Buccola and Spector, 2016), but only if the MN has another plural expression in its scope. We will connect this effect to an independently motivated presupposition associated with such non-maximal readings, which can only be met if the MN has a plurality in its scope. Combined with our surface-compositional semantics for MNs in cumulative sentences, this yields the right distribution of non-maximal readings.

2. ‘Split scope’ of modified numerals in cumulative sentences

Building on Schmitt’s (2019) analogous argument for plural definites, we first show that MNs participating in cumulativity may be interpreted in situ. Consequently, the position where the plural component of the MN is interpreted and the scope site of its maximality condition do not always coincide.³ Consider (8a), which is true in scenario (8b) on one of its readings.

(8) a. *Die zwei Tutoren haben vom Carl verlangt, [p genau zwei Artikel zu lesen]*
the two TAs have of Carl required exactly two papers PRT read.INF
and a book summarize.INF
‘The two TAs required Carl to read exactly two papers and summarize a book.’

b. SCENARIO: Last week, Carl had to miss two classes. He asked the TAs what he should do to catch up. The TA for class 1 told him to read paper 1. The TA for class 2 told him to read paper 2 and summarize one of the books on the syllabus.

The relevant reading involves a cumulative interpretation of the predicate conjunction relative to the two TAs: Since the TA for class 1 did not tell Carl to summarize a book, a distributive reading of the predicate conjunction does not capture scenario (8). But the MN ‘exactly two papers’ also has a cumulative interpretation relative to the two TAs: Neither TA asked Carl to read more than one paper. Thus, the predicate conjunction and the MN both have plural denotations that are relevant for the cumulative reading of the sentence, but the predicate conjunction contains the MN. This configuration is a problem for any analysis which, as sketched above, derives cumulative readings by syntactically deriving the relevant cumulative relation: Moving only the plural subject and the predicate conjunction would create the relation in (9a) and thus fail to account for the cumulative reading of the MN. Moving the MN and the plural subject yields the relation in (9b), leaving the cumulative reading of the predicate conjunction unexplained. And moving first the MN and then the remnant of the predicate conjunction yields a configuration with an unbound trace that has the wrong meaning (see Schmitt, 2019 for details).

(9) a. $\lambda P_{(e,t)}, \lambda x e.x$ required Carl to do P

b. $\lambda y e, \lambda x e.x$ required Carl to read y and summarize a book

We obtain a more adequate paraphrase of the cumulative reading of (8a) if we take both the part structure introduced by the MN and the part structure introduced by the predicate conjunction

³Schein (1993) makes a related point within a very different theory of plurality. In our terms, he shows that the part structure introduced by a MN in the scope of a distributive operator interacts with the cumulative interpretation of plurals outside the scope of that operator. It is therefore impossible to interpret all the plurals ‘participating’ in cumulativity at the same scope site. (8a) extends this conclusion to examples without distributive operators.
into account. Ignoring the maximality condition for a moment, (8a) can be paraphrased as saying that the TAs stand in a cumulative relation to a sum of three predicates like (10).

(10)  \[ \lambda x. x \text{ reads paper 1} + \lambda x. x \text{ reads paper 2} + \lambda x. x \text{ summarizes a book} \]

To derive a meaning along the lines of (10), the MN in (8a) (or at least the part of this DP that contributes pluralities of papers) must be interpreted in the scope of the predicate conjunction. What are the consequences of this result for the analysis of the maximality condition? Several analyses of cumulative readings of MN (Krifka, 1999; Landman, 2000; Brasoveanu, 2013) compute the maximality condition in a separate semantic dimension: Starting from an ‘ordinary’, non-maximal cumulative interpretation, the maximality condition is added at the sentence level and ends up taking scope over all plurals participating in the cumulative relation. For (8a), this would mean that the maximality condition takes scope above the matrix subject. This matches our intuitions about its interaction with the intensional verb ‘verlangt’ ‘required’: The potential paraphrase (11a), which quantifies over numbers higher than 2 in the scope of ‘required’, is false in (8b), since it entails that reading more than two papers was forbidden. In the more adequate paraphrase (11b), the maximality condition outscopes ‘required’.

(11)  a. ‘For every world \( w \) in which the TAs’ requirements (taken together) are satisfied, there is no number \( n > 2 \) such that Max reads \( n \) books in \( w \).’

b. ‘There is no number \( n > 2 \) such that for every world \( w \) in which the TAs’ requirements (taken together) are satisfied, Max reads \( n \) books in \( w \).’

In sum, (8a) shows that existing arguments against a ‘symmetric’ analysis of cumulative sentences, where all relevant plurals move to the same scope site, extend to MNs: The MN in (8a) must remain within the predicate conjunction, which is in the scope of ‘required’. Yet, the maximality condition appears to outscope ‘required’, hence for this meaning component of MNs, a ‘scopeless’ analysis could still be correct: (8a) does not falsify an analysis in which maximality comes in at the level of the root clause. We will now describe a system that combines the two-dimensional approach to maximality (Krifka, 1999; Landman, 2000; Brasoveanu, 2013) with the Plural Projection approach to cumulativity, which was motivated by data analogous to (8a) and will allow us to derive cumulative readings while interpreting all plurals in situ.

3. Plural Projection

The Plural Projection system has two crucial traits. First, by default, an expression containing a semantically plural subexpression will itself count as semantically plural, regardless of its type. This requires a notion of plurality that extends to abstract model-theoretic objects like functions and truth values. For instance, as DP1 in (12) contributes pluralities of individuals, VP1 contributes pluralities of predicates, S1 pluralities of propositions and VP2 pluralities of predicates. This ‘projection’ mechanism for semantic plurality gives us a way of interpreting plurals in cumulative sentences in situ, which we will need to model the ‘split scope’ of MNs.

(12)  \[ [s_2 \text{ [DP2 the two TAs] [VP2 made [s_1 Carl [VP1 read [DP1 two papers]]]]}] \]

If DP1 is interpreted in situ, we cannot derive the cumulative reading of (12) via a cumulative relation between people and things they made Carl read, as there is no constituent denoting

\[^4\text{For reasons of space, we cannot spell out all the formal details of the system here; for a more precise discussion and independent support for the components of the analysis, see Schmitt (2019) and Haslinger and Schmitt (2018).}\]
Cumulative readings of modified numerals: A plural projection approach

3.1. Cross-categorial plurality and plural sets

The idea that functional and propositional expressions can be plural requires a non-standard ontology. First, we posit a cross-categorial plurality-forming operation, which is primitive even for functional types. For example, one-place predicates can be summed up via an operation $\text{P}_e$ which is not reducible to the sum operation on $D_e$ or to conjunction in $D_e$.\(^5\) We associate every semantic type $a$ with an atomic domain $A_a$ and a full domain $D_a$ which also includes pluralities formed from the elements of $D_a$. The full domain $D_a$ is closed under an operation $\text{P}_a$ which maps any subset of $D_a$ to its sum. We stipulate that the structures $(\mathcal{P}(A_a)\setminus\{\emptyset\}, \cup)$ and $(D_a, \text{P}_a)$ must be isomorphic. Thus, the elements of $D_a$ are in a one-to-one correspondence with non-empty subsets of $A_a$. This is illustrated for individuals in (13a) and for one-place predicates in (13b). (We suppress type subscripts on $\text{P}$ and write $a+b$ for $\text{P}({\{a,b\}})$.)

(13) a. If $a, b, c \in A_e$, then $\{a, b, c, a+b, b+c, a+c, a+b+c\} \subseteq D_e$.
    
b. If $P, Q, [\lambda x_e. P(x) \lor Q(x)] \in A_{(e,t)}$, then $\{P, Q, [\lambda x_e. P(x) \lor Q(x)], P+Q, P+[\lambda x_e. P(x) \lor Q(x)], Q+[\lambda x_e. P(x) \lor Q(x)], P+Q+[\lambda x_e. P(x) \lor Q(x)]\} \subseteq D_{(e,t)}$.

Furthermore, semantically plural expressions do not simply denote pluralities from some domain $D_a$, but actually alternative sets containing such pluralities – what we call plural sets. Thus, besides the enriched domain $D_a$, there will be a type $a^*$ of plural sets with elements from $D_a$. Since we do not want plurals with ‘parts’ of type $a$ (say, conjunctions with conjuncts of type $a$) to be treated like predicates of type $\langle a, t \rangle$ by the composition rules, we assume that the domain $A_{a^*}$ of plural sets and the domain $A_{(a,t)}$ of one-place predicates are disjoint, but have the same algebraic structure – the operations $\cup, \cap$ and $\setminus$ are defined on both. We will write plural sets in square brackets $[\ ]$ instead of the usual set brackets. Some examples are given in (14).

(14) a. Some elements of $A_{e^*}$: $[a, b], [a+b, b+c], [a+b+c]$
    
b. Some elements of $A_{(e,t)^*}$: $[\text{smoke, drink}], [\text{smoke+dink, drink} + [\lambda x_e. \text{drink}(x) \lor \text{smoke}(x)]], [\text{smoke+dink} + [\lambda x_e. \text{drink}(x) \lor \text{smoke}(x)]]$

Our use of an extra level of plural sets is closely related to Alternative Semantics treatments of indefinites (Kratzer and Shimoyama, 2002). In particular, at the level of the root clause, we will obtain a set of pluralities of propositions and get to our truth conditions by existentially quantifying over this set. Before discussing the compositional system, we give some examples of expressions whose meanings involve plural sets in a non-trivial way.

3.2. Expressions that introduce plurality

Consider first some sample denotations for plural expressions, given the toy model (15a). Plural definites denote singleton plural sets containing the maximal element of the NP denotation (15b). In the interpretation of indefinites, on the other hand, plural sets play a non-trivial role:

\(^5\)See Schmitt, 2019 for motivation of this move.
two papers denotes the set of all pluralities of two papers (15c).

\[
\begin{align*}
(15) & \quad \text{a. } \llbracket \text{paper} \rrbracket = \{p1, p2, p3\}, \llbracket \text{book} \rrbracket = \{b1, b2\} \\
& \quad \text{b. } \llbracket \text{the papers} \rrbracket = [p1 + p2 + p3] \\
& \quad \text{c. } \llbracket \text{two papers} \rrbracket = [p1 + p2, p1 + p3, p2 + p3]
\end{align*}
\]

We take conjunction to denote an operation \( \bigoplus_a \) which maps any nonempty set \( S \subseteq D_a \) to a single element of \( D_a \). If the elements of \( S \) are not plural sets, they are simply summed up using \( \bigvee \), but for plural sets, the semantic contribution of \( \bigoplus \) is more complex: It forms the set of all pluralities obtained by selecting an element from each set in \( S \) and summing up the selected elements.

\[
\begin{align*}
(16) & \quad \text{a. For any type } a, \text{ the operation } \bigoplus_a : \mathcal{P}(D_a) \setminus \{\emptyset\} \rightarrow D_a \text{ is defined as follows:} \\
& \quad \text{For any nonempty } S \subseteq D_a: \\
& \quad \text{ (i) If } a \text{ is a non-plural type (i.e. } a \text{ is not of the form } b^*: \bigoplus_b S = \bigvee_b S. \\
& \quad \text{ (ii) If } a = b^* \text{ for some type } b: \bigoplus_b S = \{\{X^* \mid X^* \in S\}\mid f \text{ is a function from } S \text{ to } D_b \land \forall X^* \in S : f(X^*) \in X^*\}
\end{align*}
\]

\[
\begin{align*}
(17) & \quad \text{a. } \llbracket \text{paper 1, paper 1 and paper 3} \rrbracket = [p1] \oplus [p2] \oplus [p3] = [p1 + p2 + p3] \\
& \quad \text{b. } \llbracket \text{two papers and a book} \rrbracket = [p1 + p2, p1 + p3, p2 + p3] \oplus [b1, b2] = [p1 + p2 + b1, p1 + p3 + b1, p2 + b2, p1 + p3 + b2, p2 + p3 + b2] \\
& \quad \text{c. } \llbracket \text{read and summarize} \rrbracket = [(\lambda x. \lambda y. \text{read}(x)(y)) + (\lambda x. \lambda y. \text{summarize}(x)(y))]
\end{align*}
\]

(17c) illustrates one application of higher-type pluralities: analyzing plural-based readings of conjunctions of any type (Schmitt, 2019). More importantly, we can now implement the two assumptions sketched above – that cumulativity arises in local function-argument configurations, and that an expression with a semantically plural subexpression is itself plural.

3.3. Projection and Cumulative Composition

We first illustrate the results the composition mechanism should deliver for example (12). The embedded VP1 receives the denotation in (18a), which preserves the structure of the plural set \( \llbracket \text{two papers} \rrbracket \) in (15c). Informally speaking, (18a) is the result of applying the function \text{read} (abbreviated as \( \text{R} \)) ‘pointwise’ to the atoms of the pluralities in (15c). Similarly, for the embedded clause S1 in (12), we derive a plural set of propositions (18b) by pointwise application of the atoms in (18a) to Carl. Finally, we apply the matrix verb \text{make} to each atomic proposition in (18b), resulting in another plural set of predicates, (18c).\(^6\)

\[
\begin{align*}
(18) & \quad \text{a. } \llbracket \text{read two papers} \rrbracket = [\text{R}(p1) + \text{R}(p2), \text{R}(p1) + \text{R}(p3), \text{R}(p2) + \text{R}(p3)] \\
& \quad \text{b. } \llbracket \text{Carl read two papers} \rrbracket = [\text{R}(p1)(c) + \text{R}(p2)(c), \text{R}(p1)(c) + \text{R}(p3)(c), \text{R}(p2)(c) + \text{R}(p3)(c)] \\
& \quad \text{c. } \llbracket \text{make Carl read two papers} \rrbracket = [\text{make}(\text{R}(p1)(c)) + \text{make}(\text{R}(p2)(c)), \\
& \quad \text{make}(\text{R}(p1)(c)) + \text{make}(\text{R}(p3)(c)), \text{make}(\text{R}(p2)(c)) + \text{make}(\text{R}(p3)(c))]
\end{align*}
\]

To interpret the matrix clause S2, we must compose (18c) with the plural set contributed by the

\(^6\)We here assume that \( D_t \) is the set of all propositions (sets of possible worlds), not the set of truth values: \text{make} is thus a type \( \langle t, (e, t) \rangle \) function that combines with its argument via ordinary functional application.
subject DP, (19a), in a way that encodes cumulativity. The required cumulative truth conditions can be stated as follows: There is a predicate plurality $P$ in (18c) such that each atomic part of $P$ is satisfied by at least one atomic part of $t_1 + t_2$ and each atomic part of $t_1 + t_2$ satisfies at least one atomic part of $P$. Importantly, instead of directly mapping (18b) and (19a) to a proposition expressing this condition, we now introduce a rule that maps them to a set of pluralities of propositions, each of which essentially corresponds to a different cumulative scenario. Some sample elements of this set are given in (19b). Each element will be the result of combining the atoms of some predicate plurality from (18c) with the atoms of some individual plurality from (19a), such that each atom of the predicate plurality is used at least once and each atom of the individual plurality is used at least once. This is formalized by the notion of a cover (20): A cover is a relation between predicate parts and matching argument parts such that each atomic part of the predicate, as well as each atomic part of the argument, occurs in the relation.

\[
\text{The new composition rule, Cumulative Composition (CC) (21), proceeds as follows: It takes a plural set of type } \langle a,b \rangle^+ \text{ (the ‘function set’) and a plural set of type } a^+ \text{ (the ‘argument set’). For every relation } R \text{ that is a cover of some plurality in the function set and some plurality in the argument set, it performs functional application for each function-argument pair in } R \text{ and sums up the results, creating a plurality of type } b. \text{ The type } b \text{ pluralities obtained for the different covers are finally collected into a plural set of type } b^+. \text{ The reader can check that this rule yields the plural set indicated in (19b) when applied to (18c) and (19a). This plural set, which is of type } t^+, \text{ can then be mapped to a truth value via definition (22) – which states that a plural set of propositions is true iff it contains at least one plurality all atomic parts of which are true.}
\]

\[
\text{(20): A}\]

\[
\text{Cumulative Composition (CC) (21), proceeds as follows: It takes a plural set of type } \langle a,b \rangle^+ \text{ (the ‘function set’) and a plural set of type } a^+ \text{ (the ‘argument set’). For every relation } R \text{ that is a cover of some plurality in the function set and some plurality in the argument set, it performs functional application for each function-argument pair in } R \text{ and sums up the results, creating a plurality of type } b. \text{ The type } b \text{ pluralities obtained for the different covers are finally collected into a plural set of type } b^+. \text{ The reader can check that this rule yields the plural set indicated in (19b) when applied to (18c) and (19a). This plural set, which is of type } t^+, \text{ can then be mapped to a truth value via definition (22) – which states that a plural set of propositions is true iff it contains at least one plurality all atomic parts of which are true.}
\]

\[
\text{(21): Cumulative Composition (CC)}
\]

\[
\text{a.}\]

\[
\forall p \in p^{+1}(P), x \in p^{+1}(x): R \text{ is a cover of } (P,x)
\]

\[
\text{b.}\]

\[
\text{For any meaningful expressions } \phi \text{ of type } \langle a,b \rangle^+ \text{ and } \psi \text{ of type } a^+, [\phi \psi] \text{ is a meaningful expression of type } b^+, \text{ and } [\phi \psi] = \mathcal{C}([\phi], [\psi]).
\]

\[
\text{(22): The truth value of an expression } \alpha \text{ of type } t^+ \text{ in a world } w \text{ is 1 iff } \exists p \in [\alpha]. \forall p' \leq_a p.p'(w) = 1 \text{ and 0 iff } \forall p \in [\alpha]. \exists p' \leq_a p.p'(w) = 0.
\]

Since $a$ and $b$ in (21) may be arbitrary types, this rule generalizes immediately to ‘subsentential’ instances of cumulativity. For example, the embedded VP in (23a) is assigned the denotation in (23b) ($S$ stands for summarize) – a plural set of type $\langle e, t \rangle^+$. 

\[
\text{(23): The TAs made Carl read and summarize two papers.}
\]

\[
\mathcal{C}([R + S], [p_1 + p_2, p_1 + p_3, p_2 + p_3])
\]

\[
= [R(p_1) + S(p_2), R(p_2) + S(p_1), R(p_1) + S(p_3), R(p_3) + S(p_1)\ldots]
\]
We have now specified the semantic operation behind cumulativity, but we still seem to lack a formal account of the ‘projection’ behavior exemplified in (18). But closer inspection reveals that we get this behavior almost for free with our composition rule in (21). Consider node VP1, where the non-plural predicate \textit{read} combines with the plural set of individuals from (15c). Given what we have said so far, this configuration should lead to a type mismatch: To combine with a plural set of type $e^\ast$, the predicate would need to have type $\langle e, (e, t) \rangle^\ast$, not just $\langle e, (e, t) \rangle$.

To resolve this mismatch, we stipulate that any meaning can be shifted to a singleton plural set via the operation in (24a).\footnote{This type-shift is independently motivated within our system by the behavior of operations like conjunction: It behaves analogously for plural and non-plural conjuncts and should thus have a single lexical entry for both cases.} This allows us to apply the CC rule in (21) to $\llbracket \text{two papers} \rrbracket$ and the singleton plural set $\llbracket \text{read} \rrbracket$. Since \textit{read} is atomic, there is exactly one cover for each plurality of two papers – e.g., $\{ (\text{read}, p1), (\text{read}, p2) \}$ for the plurality $p1 + p2$. The plural set returned by the CC rule, given in (24b), thus mirrors the structure of $\llbracket \text{two papers} \rrbracket$, with \textit{read} applied ‘pointwise’ to each plurality of papers. The results in (18b) and (18c) are derived analogously.

\begin{align*}
(24) & \quad \text{a. For any type } a: \llbracket \uparrow a \rrbracket = \lambda x. a - [x] \\
& \quad \text{b. } \mathcal{C}(\llbracket \text{read} \rrbracket, \llbracket \text{two papers} \rrbracket) = \mathcal{C}(\llbracket \text{R} \rrbracket, [p1 + p2, p1 + p3, p2 + p3]) \\
& \quad = [R(p1) + R(p2), R(p1) + R(p3), R(p2) + R(p3)]
\end{align*}

To summarize, we introduced a new approach to semantic composition in plural sentences, which permits plural expressions of any category, including predicates and propositions. The default means of combining a plural expression with its sister is the CC rule which, when applied to a node whose daughters have types $\langle a, b \rangle^\ast$ and $a^\ast$, returns a plural set of type $b^\ast$. Consequently, expressions containing a semantically plural subexpression will themselves have plural meanings. This lets us reduce non-lexical cumulative relations, as in (12), to a combination of local cumulation operations, without having to assume a special LF syntax for plurals.

3.4. Back to our motivating example

We now return to our original example (8a). In the Plural Projection framework, there is no need to move the plurals from the embedded clause to a scope site in the matrix clause. This solves our dilemma concerning the cumulative reading of the predicate conjunction. To see this, consider Figure 1, a simplified version of (8a) without the numeral modifier. The structure of the plural set $\llbracket \text{two papers} \rrbracket$ projects to $\llbracket \text{read two papers} \rrbracket$: \textit{read} being a non-plural predicate, there is only one cover for each paper-plurality. The predicate conjunction then combines with two plural sets of predicates, which are combined via $\bigoplus$. The output of $\bigoplus$ is a set of pluralities consisting of three properties each: two properties that each correspond to reading some particular paper and one that corresponds to summarizing a particular book. Due to further ‘projection’ steps, the matrix VP ends up denoting a set of pluralities of three properties, where two properties correspond to making Carl read some particular paper and the third corresponds to making Carl summarize a particular book. This set cumulates with the matrix subject, yielding a set of pluralities of propositions that is mapped to a truth value via definition (22).

In sum, we are now closer to an analysis of (8a), since the compositionality puzzle posed by the cumulative VP conjunction is solved. Yet, we still cannot model the maximality conditions of MNs and, in particular, the ‘split scope’ effect observed in Section 2. Although \textit{zwei Artikel ‘two papers’} denotes a set of pluralities of \textit{exactly} two papers, the numeral in Figure 1 gets an ‘at
least' reading: As our truth definition in (22) quantifies existentially over sums of propositions which correspond to sums of two papers, we predict that the sentence can be true even if the TAs, between them, made Carl read three papers and summarize a book. So the present analysis of unmodified numerals does not generalize to MNs since it runs into the same problem as analyses based on classical existential quantification over plural individuals (cf. Section 1).

4. Adding the maximality condition to the system

Following most existing work on cumulative readings of non-upward-monotonic quantifiers (e.g. Krifka, 1999; Landman, 2000; Brasoveanu, 2013), we will assume a two-dimensional semantics for such quantifiers, resulting in two meaning components at the sentence level that are connected via the truth definition. In order not to prejudge the question how our system relates to other applications of two-dimensional semantics (such as scalar alternatives), we will call the two meaning components of an expression α the ‘lower set’ \([\alpha]^\downarrow\) and the ‘upper set’ \([\alpha]^\uparrow\).
At the level of the root clause, there will be two plural sets of propositions. The basic intuition will be that we existentially quantify over \([\alpha]^{\uparrow}\) as before – at least one plurality in \([\alpha]^{\downarrow}\) must consist of true propositions – but \([\alpha]^{\downarrow}\) additionally tells us which propositional pluralities are ‘too big’ to make \(\alpha\) true. Consider first the two-dimensional meaning of the modifier exactly \(n\) in (25). While \([\text{exactly}\ n]^{\uparrow}\) maps a predicate to the set of all sums of \(n\) individuals satisfying that predicate, \([\text{exactly}\ n]^{\downarrow}\) yields the set of all sums of \(n\) or more such individuals.\(^8\) For most non-quantificational expressions, the two meaning components are identical, (26).

(25) a. \([\text{exactly}\ n]^{\uparrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid |x| = n \land P(x)]\)

b. \([\text{exactly}\ n]^{\downarrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid |x| \geq n \land P(x)]\)

(26) If, for some expression \(\alpha\), \([\alpha]^{\downarrow}\) is specified in the lexicon without specifying the dimension (\(\uparrow\) or \(\downarrow\)), then \([\alpha]^{\uparrow} = [\alpha]^{\downarrow} = [\alpha]\).

For a complex expression, composition proceeds for both dimensions in parallel: Its lower set is obtained by combining the lower sets of its daughter nodes, using whichever semantic rule is applicable – the CC rule or regular functional application. Its upper set is obtained in the same way from the upper sets of its daughter nodes. For instance, the two meaning components of exactly two students are computed by applying the functions in (25) to \([\text{student}]^{\uparrow}\):

(27) a. \([\text{exactly two students}]^{\uparrow} = [\text{exactly two}]^{\uparrow}( [\text{students}]^{\uparrow}) = [x \in D_e \mid |x| = 2 \land \text{students}(x) = [a + b, b + c, a + c]\) for \([\text{student}] = [a, b, c]\)

b. \([\text{exactly two students}]^{\downarrow} = [\text{exactly two}]^{\downarrow}( [\text{students}]^{\downarrow}) = [x \in D_e \mid |x| \geq 2 \land \text{students}(x) = [a + b, b + c, a + c, a + b + c]\) for \([\text{student}] = [a, b, c]\)

Let us say we want to derive a denotation for (4) by composing (27) with the non-plural predicate failed the exam. To combine with plural sets, both components of the latter must be shifted to the singleton plural set \([\text{fail}]^{\uparrow}\). We then apply the CC rule for each of the two dimensions:

(28) a. \([\text{exactly two students failed}]^{\uparrow} = \mathcal{C}( [\text{fail}]^{\uparrow}, [\text{exactly two students}]^{\uparrow}) = [\text{fail}(a) + \text{fail}(b), \text{fail}(b), \text{fail}(c), \text{fail}(a) + \text{fail}(c)]\)

b. \([\text{exactly two students failed}]^{\downarrow} = \mathcal{C}( [\text{fail}]^{\downarrow}, [\text{exactly two students}]^{\downarrow}) = [\text{fail}(a) + \text{fail}(b), \text{fail}(b) + \text{fail}(c), \text{fail}(a) + \text{fail}(b), \text{fail}(a) + \text{fail}(b) + \text{fail}(c)]\)

How does such a pair of plural sets of propositions map to a truth value? Intuitively, a sentence

---

\(^8\) Corresponding lexical entries for two other numeral modifiers are given in (i) and (ii). Note that for at least \(n\), the two components are identical, which corresponds to the intuition that it lacks a maximality condition. Lexical entries like (i), (ii) and (25) can be derived systematically from the classical non-plural generalized-quantifier meaning of numeral modifiers (cf. (iii)). This suggests that (i), (ii) and (25) do not reflect the basic meaning of numeral modifiers. There is one potential reason to assume that the non-plural generalized-quantifier meanings of MNs play a role in the grammar: at most \(n\) lacks an existential entailment when combined with distributive predicates. However, we think it also lacks this entailment in some cumulative sentences, indicating that instead of positing a separate non-plural meaning, one should revise the plural meaning in (i).

(i) a. \([\text{at most}\ n]^{\uparrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid |x| \leq n \land P(x)]\)

b. \([\text{at most}\ n]^{\downarrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid P(x)]\)

(ii) \([\text{at least}\ n]^{\uparrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid |x| \geq n \land P(x)]\)

(iii) For a determiner \(Q\) of type \((e, t), (e, t, t)^2\), we can derive meanings \([Q]^{\uparrow}\) and \([Q]^{\downarrow}\) as follows:

a. \([Q]^{\uparrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid P(x) \land [Q](\lambda y, x)\mid y \leq x]\)

b. \([Q]^{\downarrow}\ = \lambda P_{(e,t)}. [x \in D_e \mid P(x) \land \exists y \mid y \leq x \land y \in [Q]^{\uparrow}(\lambda y, x)]\)
will count as true if there is a plurality \( p \) in its lower set that consists only of true propositions, and there is no plurality \( q \) in the upper set that consists only of true propositions and properly contains \( p \) as a part. We formalize this by introducing an operator \( \mathcal{W} \) that maps the two meaning components of an expression of type \( t^* \) to a single proposition:

\[
\text{(29) } \quad \text{a. For two plural sets } L, U \in D_r : \quad \mathcal{W}(L, U) = \lambda w. \exists p \in L. \forall p' \leq p \, p'(w) = 1 \land \exists q \in U. p < q \land \forall q' \leq q \, q'(w) = 1
\]

\[
\text{b. The truth value of an expression } \phi \text{ of type } t^* \text{ in a world } w \text{ is } \mathcal{W}([\phi]^\downarrow, [\phi]^\uparrow)(w).
\]

According to (29), (4) is true if the following holds: First there must be a propositional plurality in (28a) that consists only of true parts. This is the case whenever there are two students who failed the exam. Second, there must be at least one such plurality that is not a proper part of a plurality in (28b) that only has true parts. This second condition is met whenever exactly two students failed. But if there is a sum of three students who failed, it will correspond to a plurality of three true propositions in (28b) which has proper parts in (28a), making the sentence false.

Now consider the maximality conditions of the MNs in the cumulative sentence (1a). The lower set of \textit{exactly two books} contains all sums of two books. The structure of this set ‘projects’ when combined with [\text{read}] via CC (30a). Another application of CC yields the lower set at the clausal level (30b), which contains the propositional pluralities that ‘cover’ two books and two students. In contrast, the upper set of the VP also contains predicate pluralities that amount to reading more than two books (30c) – and at the sentence level, the upper set contains propositional pluralities which only count as true if more than two students read books, and propositional pluralities which only count as true if more than two books were read by students (30d). Recall that all scenarios in (5) above make (1a) false. Each corresponds to a propositional plurality that is in (30d), but not in (30b), and has proper parts in (30b). In each scenario, there will be some pluralities in (30b) that consist of only true propositions, but definition (29) predicts (1a) to be false as all such pluralities are proper parts of an element of (30d).

\[
\text{(30) } \quad \left[\text{\textit{student}}\right] = [a, b, c]. \quad \left[\text{\textit{book}}\right] = [b_1, b_2, b_3]
\]

\[
\text{a. } \left[\text{\textit{read exactly two books}}\right]^\downarrow = \mathcal{C}(\left[\text{\textit{read}}\right], \left[\text{\textit{exactly two books}}\right]^\downarrow) = \left[\text{R}(b_1) + \text{R}(b_2), \text{R}(b_2) + \text{R}(b_3), \text{R}(b_1) + \text{R}(b_3)\right]
\]

\[
\text{b. } \left[\text{\textit{exactly two students read exactly two books}}\right]^\downarrow = \left[R(b_1)(a) + R(b_2)(b), R(b_1)(b) + R(b_2)(a), R(b_1)(a) + R(b_2)(a) + R(b_2)(b), \ldots\right]
\]

\[
\text{c. } \left[\text{\textit{read exactly two books}}\right]^\uparrow = \mathcal{C}(\left[\text{\textit{read}}\right], \left[\text{\textit{exactly two books}}\right]^\downarrow) = \left[\text{R}(b_1) + \text{R}(b_2), \text{R}(b_2) + \text{R}(b_3), \text{R}(b_1) + \text{R}(b_3), \text{R}(b_1) + \text{R}(b_2) + \text{R}(b_3)\right]
\]

\[
\text{d. } \left[\text{\textit{exactly two students read exactly two books}}\right]^\uparrow = \left[R(b_1)(a) + R(b_2)(b), R(b_1)(b) + R(b_2)(a), R(b_1)(a) + R(b_2)(a) + R(b_2)(b), \ldots, R(b_1)(a) + R(b_2)(b) + R(b_3)(b), R(b_1)(a) + R(b_2)(b) + R(b_2)(c), \ldots\right]
\]

We now return to our original puzzle concerning example (8a), which contains the MN \textit{exactly two papers} embedded in a VP conjunction. The lower set of this VP conjunction is the same as the denotation we computed in Figure 1 for the corresponding VP without a numeral modifier (31a). The upper set additionally contains predicate pluralities that amount to reading more than two papers and summarizing a book, like \( R(p_1) + R(p_2) + R(p_3) + S(b_1) \) in (31b). (32a) gives some examples of propositional pluralities that are in the lower set at the sentence level (which is the plural set computed in Figure 1). Crucially, the structure of (31b) will project to the upper set of (8a) in a completely analogous manner (32b). Unlike (32a), (32b) will also
contain sums of propositions which intuitively express that the TAs, between them, required Carl to read a certain sum of more than two papers and summarize a certain book.

\[(31) \quad \text{a. } \llbracket \text{read exactly two papers and summarize a book}\rrbracket^\uparrow = [R(p1) + R(p2) + S(b1), R(p1) + R(p3) + S(b2), \ldots]\n\]

\[(31) \quad \text{b. } \llbracket \text{read exactly two papers and summarize a book}\rrbracket^\downarrow = [R(p1) + R(p2) + S(b1), R(p1) + R(p3) + S(b2), \ldots, R(p1) + R(p2) + R(p3) + S(b1), R(p1) + R(p2) + R(p3) + S(b2), \ldots]\n\]

\[(32) \quad \text{a. } \llbracket (8a) \rrbracket^\uparrow = [\text{req}(R(p1)(c))(t1) + \text{req}(R(p2)(c))(t2) + \text{req}(S(b1)(c))(t2), \text{req}(R(p1)(c))(t2) + \text{req}(R(p3)(c))(t1) + \text{req}(S(b2)(c))(t2), \ldots]\n\]

\[(32) \quad \text{b. } \llbracket (8a) \rrbracket^\downarrow = [\text{req}(R(p1)(c))(t1) + \text{req}(R(p2)(c))(t2) + \text{req}(S(b1)(c))(t2), \text{req}(R(p1)(c))(t2) + \text{req}(R(p3)(c))(t1) + \text{req}(S(b2)(c))(t2), \ldots,\text{req}(R(p1)(c))(t1) + \text{req}(R(p2)(c))(t2) + \text{req}(R(p3)(c))(t2) + \text{req}(S(b1)(c))(t2), \ldots]\n\]

In a scenario where the TAs, between them, assigned three papers to Carl and one of them made him summarize a book, (32b) will contain a sum that consists only of true propositions. As this plurality will have proper parts in (32a), but is not itself in (32a), (8a) is correctly predicted to be false. But if there are exactly two papers Carl was required to read by the TAs, and one book he had to summarize, this will translate into a propositional plurality in (32a) that is not a proper part of any true element of (32b), and the sentence is predicted to be true. Thus, we now have an account of the seemingly conflicting properties of cumulative sentences with MNs: We can interpret the plurals in situ, while the maximality condition is read off at the sentence level.

5. Non-maximal readings of MNs and syntactic asymmetries

We have modelled two properties of cumulative sentences: The fact that the ‘plural component’ of MNs in cumulative sentences is interpreted in situ, and the maximality condition. We will now show that there is an interesting relation between these seemingly independent components: MN can have non-maximal readings, but only in some syntactic configurations. This interaction between the maximality condition and the syntactic position of a MN supports our asymmetric treatment of cumulativity. Yet, the non-maximal reading only surfaces under a certain pragmatic condition that resembles the presuppositions of scalar particles like even. We will formulate this condition in such a way that it can only be met if the MN combines with a set of non-trivial pluralities via CC, which will derive the distribution of non-maximal readings.

5.1. Syntactic constraints on the non-maximal reading: Sensitivity to scope

Like our example in (1a), the German sentence in (33a) contains two MNs and has a cumulative reading. Yet, it can be be true in the ‘non-maximal cumulative’ scenario (33b), where more than 2 students read books (cf. Buccola and Spector, 2016 for similar English examples).

\[(33) \quad \text{a. } \text{Genau zwei Studenten haben genau 100 Bücher gelesen.} \]

\[(33) \quad \text{b. } \text{SCENARIO: A read 60 and B 40 books. C also read some of these books.}\]

---

9This is not predicted by previous analyses, which either only derive the maximal reading (Krifka, 1999; Landman, 2000; Brasoveanu, 2013) or derive non-maximal readings ‘across the board’ (Buccola and Spector, 2016).
Importantly, the availability of such non-maximal readings is tied to the syntactic position of the MN (Schmitt, 2015): They are only possible if the MN c-commands (or, simplifying, outscopes) another plural expression. This is illustrated in (34). (34b), where the MN subject *genau drei Wiener* (‘exactly three Viennese’) c-commands the plural object PP, is true in the ‘non-maximal’ scenario in (34a). But (34c), where the plural object PP has been scrambled across the subject – and the latter thus no longer c-commands a plural expression – lacks the non-maximal reading for the MN – the sentence is false in the scenario.\(^{11}\)

(34) a. **scenario**: A remote village has 50 inhabitants. Three Viennese people have many friends there: A is friends with 15 villagers, B with another 15, C with the remaining 20. Some other Viennese people have one or two friends there.

b. *Anscheinend sind genau drei Wiener mit allen Dorfbewohnern befreundet.*

‘Apparently, exactly three Viennese people are friends with all the villagers.’

5.2. Pragmatic constraints on the non-maximal reading: The ‘surprise condition’

The availability of non-maximal readings in cumulative sentences is not just constrained by the syntactic position of the MNs. In (35a), *genau zwei Studenten* c-commands another plural, but cannot get a non-maximal reading: (35a) is false in the ‘non-maximal’ scenario in (35b).

(35) a. *Genau zwei Studenten haben genau drei Bücher gelesen.*

‘Exactly two students read exactly three books.’


The contrast between (35a) and (33a) must be tied to the number of books read, since the sentences are otherwise identical. We submit that it is connected to an intuitive notion of ‘surprise’ or ‘unexpectedness’. Assuming that people usually read 1-2 books, it is significantly more surprising that two students (so few students!) cumulatively read 100 books than if some larger plurality of students (say, 50) had done so. But since it is expected, and thus not surprising, for two students to cumulatively read three books, this is not significantly more unexpected than if some larger plurality of students had done so. We will now try to derive the distribution of non-maximal MNs from this ‘pragmatic’ constraint. Not only is it related to the restriction that the MN must have a plural in its scope in cumulative sentences – it will also explain why MNs with distributive predicates never permit non-maximal readings (as pointed out by Buccola and Spector, 2016 for English), regardless of the material in their scope.

The basic idea is the following. Non-maximal readings of MNs can only occur under a certain condition, which involves a ‘significantly more surprising’ (henceforth ‘more surprising’) relation that is probably related to the semantics of scalar particles like *even*. We will not attempt to formalize this relation here, but note that 1) it must be context-dependent and 2) a proposition

\(^{10}\)A different kind of interaction between cumulativity and c-command or scope is found with *every*-DPs (Cham‐pollion, 2010) and related expressions in German and other languages (Haslinger and Schmitt, 2018, 2019), cf. the data in Schein, 1993; Kratzer, 2003. Yet, Haslinger and Schmitt (2019) argue that a direct correlation with scope does not capture the German data and appeal to additional constraints on c-command relations at different derivational stages. We have not yet investigated whether the data involving MNs also warrant such a qualification.

\(^{11}\)The MN has the same thematic role in (34b) and (34c), hence the constraint cannot be captured in terms of thematic roles (as assumed by Buccola and Spector, 2016 for non-maximal readings more generally).
clearly cannot be more surprising than a proposition \( q \) if \( q \) entails \( p \).\(^{12}\) (However, we will not identify the relation with ‘less probable’, given the issues Greenberg, 2016 raises for the case of even.) For a given MN like *exactly two students*, the condition requires that it is more surprising that some plurality in the lower set of the MN satisfies the predicate expressed by the sister of the MN (e.g., some plurality of exactly two students cumulatively read exactly 100 books) than that some larger plurality in the upper set has this property (e.g., some plurality of more than two students cumulatively read exactly 100 books). If the condition holds, the MN may be interpreted as non-maximal, while the maximality conditions of other plurals are unaffected.

Given this informal description, let us see how this condition interacts with our previous assumptions to derive the distribution of non-maximal readings. For a distributive predicate \( P \), it cannot be more surprising that some plurality of exactly two students is \( P \) than that some plurality of more than two students is \( P \), since the latter statement entails the former. We thus predict distributive sentences to lack non-maximal readings. To account for the structural asymmetry in cumulative sentences like (33a) or (35a), it is crucial that the surprise condition makes reference to the sister of the MN in question. Since our plural projection semantics from Section 3 derives cumulativity in several steps rather than forming a cumulative relation right away, there is a crucial difference between the sister of the syntactically lower MN and the sister of the syntactically higher MN: Only the latter will denote a non-trivial plural set. This property of our semantics is behind the observation in (34) that only MNs with a plural in their scope have non-maximal readings. If we combine the predicate in the scope of the lower plural – [read] in (33a) and (35a) – with a non-plural subject \( x \), it cannot be more surprising that \( x \) read a plurality of exactly three books than that \( x \) read a plurality of more than three books, since the latter condition entails the former. So the surprise condition can never be met for the lowest MN in a cumulative sentence, which is thus expected to behave like MNs in distributive sentences and disallow non-maximal readings. In contrast, the higher MN combines with a non-trivial plural set (created via projection of the lower plural). Hence, we do not get the ‘automatic’ entailment relation that conflicts with the surprise condition in the other cases: It is possible that more than two students cumulatively read 100 books while no plurality of exactly two students cumulatively read 100 books. In sum, the surprise condition can only be met if the MN has another plural in its scope. Assuming that students usually read 1-2 books each, it will hold in (33a) (it is more surprising that some plurality of exactly 2 students cumulatively read exactly 100 books than that some plurality of more than 2 students did so), but not in (35a).

5.3. A preliminary analysis sketch

We now show informally how this idea can be added to the system developed in the previous sections. We posit an operator \( \mathcal{S} \), defined in (36): It attaches to DPs (\( \psi \)) and considers certain results of combining their denotations with the denotations of their scope (\( \phi \)). The presupposition of \( \mathcal{S} \) encodes the surprise condition: It relates two propositions \( p, q \), requiring that \( p \) is significantly more surprising than \( q \). Each of \( p \) and \( q \) is derived by applying our truth-definition

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\(^{12}\)The role of entailment here closely resembles Buccola and Spector’s (2016) pragmatic account for the lack of non-maximal readings in distributive sentences. On both accounts, it is crucial that distributive predication gives rise to a certain entailment pattern, but cumulative predication does not. Their proposal differs from ours in that our relation is meant to be stronger than entailment (based on the contrast between (33a) and (35a)) and in the way it interacts with the compositional semantics.
(29) to a pair of plural sets derived via CC: $p$ states that there is a plurality in the lower set of the MN, which is such that one of the predicate pluralities in the lower set of $\phi$ – but no larger predicate plurality in the upper set of $\phi$ – cumulatively holds of it. $q$ states that there is a plurality in the upper set of the MN which is not in its lower set and which is such that one of the predicate pluralities in the lower set of $\phi$ – but no larger predicate plurality in the upper set of $\phi$ – cumulatively holds of it. So, if our MN is *exactly two students*, $p$ will relate to pluralities of two students, and $q$ will relate to pluralities of more than two students, and both $p$ and $q$ will ‘preserve’ maximality conditions imposed by elements in the scope of the MN. If defined, the operator yields a new pair of plural sets: The lower set is obtained by CC in the usual way, but the upper set results from CC combining again the MN’s lower set with the upper set of $\phi$. Thus, $[[S]]$ removes the effect of the maximality condition from the MN denotation.

\[(36) \quad [[S]] and [[S]] are defined only if \[W'(C([[\phi]), [[\psi]]), C([[\phi]), [[\psi]]) \]
\]
\[= \text{significantly more surprising than } W'(C([[\phi]), [[\psi]], C([[\phi]), [[\psi]]).} \]

a. If the definedness condition is met: $[[S]] = C([[\phi]), [[\psi]])$

b. If the definedness condition is met: $[[S]] = C([[\phi]), [[\psi]])$

Let us first see what happens when we insert this operator into the distributive sentence (4), as in (37a). The presupposition requires that (37b) is more surprising than (37c) (we use our toy model for illustration) – but this is impossible since the latter entails the former. Hence, when the operator attaches to a MN without a plural in its scope, it gives rise to a presupposition failure and we never get non-maximality. We assume that the operator is optional, but cannot be inserted if it leads to automatic presupposition failure (see e.g. Abrusán, 2011).

\[(37) \quad a. [[S \text{ exactly two students}] failed the exam] \]
\[b. W'(C([[\text{fail}}]), [[S \text{ exactly two students}}]), C([[\text{fail}}]), [[S \text{ exactly two students}})) \]
\[= W'(C([F],[a + b, b + c, a + c]), C([F],[a + b, b + c, a + c])) \]
\[= \text{that there is a plurality consisting of two students that failed} \]

\[c. W'(C([[\text{fail}}]), [[S \text{ exactly two students}}]), C([[\text{fail}}]), [[S \text{ exactly two students}})) \]
\[= W'(C([F],[a + b + c]), C([F],[a + b + c])) \]
\[= \text{that there is a plurality consisting of more than two students that failed} \]

Next, we consider cumulative sentences with two plurals like (33a) or (35a). We first check what happens when $S$ attaches to the lower MN in (35a), as shown in (38a). As in (37), both meaning components of this MN’s sister yield the ‘trivial’ plural set [read], which has no interesting part structure. But as (38a) will require the operator to compare plural sets of one-place predicates, rather than propositions, a full analysis would require a cross-categorial version of (36), which space limitations prevent us from addressing. We thus make the simplifying assumption that the definedness condition checks if (36) holds whenever the predicate combines with an atomic individual. This yields the requirement in (38b) – which cannot be met. So any MN without a plural in its scope behaves like an MN in a distributive sentence: $S$ cannot adjoin to this MN, as the presupposition would never be met, and we never derive a non-maximal reading.\(^{13}\)

\(^{13}\)We here omit the discussion of collective predicates, which Buccola and Spector (2016) cite as another context where MNs exhibit non-maximal readings. First, our system for cumulativity does not yet extend to collective predicates, so the predictions we make are unclear. More importantly, the empirical situation is also unclear to us.
Finally, let us consider what happens when $\mathcal{S}$ attaches to an MN that does have a plural in its scope, as in (39a) (for our example (35a)). Here, $\mathcal{S}$ will require that the proposition in (39b) is significantly more surprising than the one in (39c). Since (39c) does not entail (39b), insertion of $\mathcal{S}$ in this case does not automatically lead to presupposition failure. This means we can now evaluate whether, given our assumptions about reading habits, (39b) is significantly more surprising than (39c). In a context where students are assumed to read 1-2 books on average, it is not, so the non-maximal reading should be blocked. But in the same context, a sentence with a higher numeral in object position, like (33a) above, would meet the surprise condition.

Thus, the restrictions on non-maximal readings follow from a particular pragmatic condition on such readings together with our two-dimensional semantics. The interesting empirical question how this condition relates to overt scalar particles must be left unresolved here.\footnote{Overt scalar particles like \textit{selbst} ($\approx$ English \textit{just} in the use discussed by Panizza and Sudo, 2019) are not very good in cumulative sentences with non-maximal readings. Yet, their semantic impact in cases without cumulativity seems very similar to the role we attribute to $\mathcal{S}$. For the moment, we leave this issue to further research.  

6. Conclusion and open problems

We developed a compositional system with the following properties: 1) Plurals in cumulative sentences are always interpreted in situ. 2) The maximality conditions associated with plural quantifiers, particularly MNs, are computed as a separate component of meaning within a two-dimensional semantics, which gives them scope over all plurals in the sentence. 3) Under certain contextual conditions, the maximality condition of MNs can be obviated, but only if they cumulate with another plural in their scope. Each of these properties is shared by some existing accounts of cumulativity for MN, but no previous analysis combines all of them.

We conclude by mentioning several problems and open questions. The most serious problem concerns a class of examples that systematically challenge assumption 2): Sentences with an MN in the scope of a distributivity operator and another MN that outscopes that operator, such as (40a). While we did not discuss distributivity yet, Haslinger and Schmitt (2019) give a Plural Projection analysis of \textit{every}. Extending this approach to \textit{each} is not trivial, but the general predictions it would make are clear: (40b) is taken to denote a set of propositional pluralities that correspond to particular assignments of two books to each student. When we add our
semantics for MNs, we get (40b) as our lower set for (40a), but the upper set would contain all propositional pluralities in which two or more students are each related to two or more books. We then predict (40a) to be false if there is a third student who read ten books, which does not seem correct. Intuitively, the problem is that the maximality condition of exactly two books should not ‘project’ unchanged through the distributivity operator.

\[(40)\]

\begin{align*}
&\text{a. Exactly two students (each) read exactly two books.} \\
&\text{b. } [\text{two students each read two books}] = [R(b_1)(a) + R(b_2)(a) + R(b_3)(b) + R(b_4)(b), R(b_1)(a) + R(b_2)(a) + R(b_2)(b) + R(b_3)(b), \ldots ]
\end{align*}

One might take this to show that distributive sentences do not involve plural sets. But this is not an option in light of the more complex examples discussed by Schein (1993), where the higher MN additionally cumulates with another plural that also outscopes each. Schein shows that the truth conditions of such sentences are sensitive to the part structure introduced by the MN embedded under each. The problem posed by (40) must therefore be solved within a theory of cumulativity. While the mixed cumulative/distributive configurations discussed by Schein do not pose a general problem for our theory (see Haslinger and Schmitt, 2019), we do have a problem with those of his examples that involve two MNs on different ‘sides’ of a distributive operator. This suggests that there should be a more complex interaction between distributivity and the two-dimensional semantics, the details of which must be left to future work.\(^{15}\)

Another issue for further research is the relation between the non-maximal reading of MNs and the special interpretation of plural definites, and plural universals like all, in cumulative sentences. Schmitt (2015) and Buccola and Spector (2016) show that it is sometimes sufficient if the cumulative predicate is true of a part of the plurality the DP introduces – e.g., (41) can be true even if some activists did not call any voters. This reading and the non-maximal reading of MNs seem to have a similar distribution (Schmitt, 2015), which suggests they are related.

\[(41)\] \text{The 50 activists called exactly 10 voters.}

Finally, our analysis of the modifiers was tailored for cumulative readings of MNs, but they are in fact cross-categorial and not restricted to numerals (Krifka, 1999). Our notion of ‘upper’ and ‘lower sets’ should thus follow from a general two-dimensional semantics for the modifiers. It is unclear how this could be done, especially in the case of scales that are not entailment-based.

References


\(^{15}\)Schein’s (1993) analysis of MNs does not face this criticism, as it is not two-dimensional. So does it account for cumulative sentences without encoding the maximality conditions in a plural-quantifier meaning for the MN – an idea we argued against in Section 1? To the extent we understand his proposal, it seems to avoid the problem discussed in Section 1 due to a syntactic LF for cumulative sentences where none of the MNs is in the scope of the others. It is, however, unclear to us 1) how maximality conditions are then computed compositionally and 2) how to encode the ‘surprise’ condition from Section 5, which is sensitive to plurals in the scope of the MN.


Restriction on evidence in evidentiality: the part-whole relation between situations

Yuto HIRAYAMA — Osaka University / JSPS

Abstract. Evidentials are traditionally defined as linguistic expressions that designate the specific type of evidence that the speaker has for the utterance (Willett, 1988; Aikhenvald, 2004). This paper deals with three indirect evidentials, the English adverb apparently, raising verb seem, and the Japanese auxiliary yooda. These three evidentials are not always felicitous even if the speaker has indirect evidence. This means that some semantic restriction is at work, independent of evidence-type specification. This paper raises empirical problems for previous studies on evidence encoded by evidentials (McCready and Ogata, 2007; McCready, 2014; Takubo, 2009; Krawczyk, 2012; Davis and Hara, 2014; Hirayama, to appear), and proposes an alternative account based on situation semantics (Kratzer, 2012; Elbourne, 2013).

Keywords: evidentials, evidence, situation semantics

1. Introduction

Evidentials are traditionally defined as linguistic expressions used to specify the evidence that the speaker’s utterance is based on (Willett, 1988; Aikhenvald, 2004). For example, the use of indirect evidentials implies that the speaker does not witness the described event directly, but rather that she has acquired certain information that indirectly supports the truth of the prejacent. If this evidence-type specification is the only contribution of evidentials, it is predicted that indirect evidentials always sound felicitous when the evidence is indirect. However, this is not borne out. The three evidentials, the English adverb apparently, raising verb seem, and the Japanese auxiliary yooda, are felicitous in (1a), but not in (1b):

(1) a. Context: You see puddles on the ground:
   (i) Apparently it rained.
   (ii) It seems that it rained.
   (iii) Ame-ga fut-ta yooda.  
       rain-NOM fall-PAST yooda  
       ‘It seems that it rained.’

b. Context: You see falling raindrops from the window:
   (i) #Apparently there are puddles.
   (ii) #It seems that there are puddles.
   (iii) #Mizutamari-ga aru yooda.  
       puddle-NOM exist yooda  
       ‘It seems that there are puddles.’ (Adapted from Davis and Hara, 2014)

In both examples, the speaker does not witness the event instantiating the prejacent proposition; that is, the speaker has indirect evidence in both cases. Nevertheless, only (1a) sounds felicitous. This means that the fact that there are puddles can serve as evidence for the inference that it rained, while the fact that it is raining does not serve as evidence for the inference that there

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are puddles. In other words, the evidence in (1a) satisfies a certain semantic condition that the

evidence in (1b) does not.

This raises the question of what condition a piece of information has to satisfy in order to

classify as evidence, in addition to the indirectness requirement, an issue that has not been
discussed so extensively in the formal literature on evidentials. Below, I will investigate the

semantic condition imposed on the evidence and the prejacent. I will survey previous studies

on this topic (the probabilistic approach: McCready and Ogata, 2007; McCready, 2014, the

abductive approach: Takubo, 2009; Krawczyk, 2012, the causal approach: Davis and Hara,

2014, and the temporal approach: Hirayama, to appear), and point out the empirical problems

relating to each.

The remainder of this paper is organized as follows. Section 2 addresses previous analyses

of evidence (that is, a meaning component independent of evidence-type specification). I will

examine McCready and Ogata (2007), McCready (2014), Takubo (2009), Krawczyk (2012),

Davis and Hara (2014), and Hirayama (to appear), demonstrating that all of them are empiri-
cally inadequate. Section 3 presents my analysis through the framework of situation semantics

(Kratzer, 2012; Elbourne, 2013). I propose a new constraint, and under my analysis, the eviden-
tials become felicitous if the prejacent and the proposition describing the evidence (henceforth,

evidence proposition) fulfill that requirement, as well as if they fulfill the restriction proposed

in Krawczyk (2012) and Davis and Hara (2014). Section 4 concludes this paper and discusses

its implications. There, I investigate the possibility of a more conceptually desirable form of

analysis, suggesting that a generalization based on counterfactual description is a possible al-

ternative to my proposal, but the question of how to formulate such an idea still needs to be

solved. Finally I demonstrate that the applicability of the proposed semantics may be beyond

the realm of indirect evidentials.

2. Previous studies

This section addresses a number of previous studies regarding the restrictions placed on the
evidence of evidentials, as well as what semantic role the presence of evidence plays. The

previous approaches reviewed in this section can be categorized into four types: the probabilis-
tic approach (McCready and Ogata, 2007; McCready, 2014), the abductive approach (Takubo,
2009; Krawczyk, 2012), the causal approach (Davis and Hara, 2014), and the temporal ap-
proach (Hirayama, to appear). I will demonstrate that the probabilistic approach is not relevant
to the contrast in (1), and that while the remaining three approaches can handle it, all of them
still contain empirical problems.

2.1. The probabilistic approach

This subsection shows that McCready and Ogata (2007) and McCready (2014), in which the

presence of evidence increases the probability of the prejacent being true, do not account for
the contrast in (1). It should be noted that their analyses are not dedicated to capturing such a
contrast; I claim that probability change is not the only restriction placed on the evidence.

Let us begin with McCready and Ogata (2007). They attempt to account for the facts about
embeddability and modal subordination of Japanese evidentials, and propose a probabilistic
dynamic logic for evidentials. In their framework, the Japanese indirect evidential yooda is de-
fined as a probabilistic function $\Delta^i$. The semantics of *yooda*-sentences is informally as follows, where $\phi$ is the prejacent:

(2) $\Delta^i \phi$ is true given a world $w$, time $s$, and probability function $\mu$ iff:

a. $\phi$ was less likely as determined by $\mu$ at some time preceding $s$ (before introduction of some piece of evidence $i$);

b. $\phi$ is probable, but still not completely certain at $s$ (given $i$);

c. the probability of $\phi$ never decreased between the time the speaker became aware of the evidence $i$ and $s$ as a result of the same piece of evidence (i.e., the probability of $\phi$ given $i$ is upward monotonic).

(McCready and Ogata, 2007: 185; McCready, 2014: 159)

The time “the speaker became aware of the evidence” in (2c) corresponds to the Evidence Acquisition Time (EAT), following the terminology in Lee (2013) and Smirnova (2013). Therefore, the contribution of indirect evidentials in (2) can be paraphrased as follows: (i) observation of the evidence makes the prejacent likely but not certain, and (ii) any other piece of evidence obtained between EAT and the utterance time does not lower the likelihood of the prejacent.

However, McCready and Ogata’s (2007) analysis in (2) does not account for the contrast in (1), as pointed out by Davis and Hara (2014). In (1a), the speaker utters the sentence immediately after she perceives the evidence (puddles on the ground). Therefore, there is no other piece of evidence between EAT and the utterance, which allows us to ignore condition (ii) above. Since the presence of puddles increases the probability that it rained, both conditions (i) and (ii) are satisfied in (1a). However, they are also satisfied in (1b). The temporal distance between EAT and the utterance is the same as (1a) (the utterance is made immediately after EAT). Therefore, we can put aside condition (ii). The fact that raindrops are falling outside makes it highly probable that there are puddles, which satisfies condition (i). As such, the analysis in (2) predicts (1b) to be felicitous as well as (1a), contrary to the fact.

McCready (2014) provides another probabilistic approach, and is concerned with her earlier claim (McCready, 2010) that the evidence referred to by evidentials must be part of the speaker’s knowledge. She concludes that the evidence must be a piece of information that both makes the prejacent more probable and that the speaker believes that she knows. As the second condition is not relevant, I cite only the first condition:

(3) Let $p$ and $q$ be the prejacent and the evidence proposition, respectively. Then, $q$ is evidence for $p$ iff $P(p|q) > P(p|\neg q)$, where $P$ is a probabilistic function and $(p|q)$ is the conditionalization of $p$ on $q$.

(Adapted from McCready, 2014: 175)

$P(p|q)$ stands for the probability that $p$ is true given that $q$ is true. Therefore, the requirement $P(p|q) > P(p|\neg q)$ means that the prejacent $p$ is more likely to be true if the evidence $q$ holds than if it does not.

However, this probabilistic definition of evidence does not account for the contrast in (1). In (1a), the probability that it rained becomes higher if there are puddles than if there are not. In (1b), the existence of puddles becomes more probable if raindrops are falling outside than if they are not. Therefore, (3) predicts both examples in (1) to be felicitous.

Even if probabilistic considerations are needed in order to explain some other phenomena, we
need another constraint to capture the contrast between (1a) and (1b). The previous studies that will be reviewed in the following subsections account for such a contrast with restrictions that exist independent of probability change.

2.2. The abductive and causal approaches

This subsection reviews two previous approaches: the abductive approach (Takubo, 2009; Krawczyk, 2012) and the causal approach (Davis and Hara, 2014), both of which can account for the contrast in (1). After demonstrating how the two approaches capture the contrast, I will present some problematic data that both wrongly exclude.

Takubo (2009) and Krawczyk (2012) propose that indirect evidentials are felicitous only if the prejacent is the conclusion of abductive reasoning in which the minor premise is the evidence proposition (Takubo addresses Japanese evidentials such as *yooda*, while Krawczyk deals with *apparently* and evidentials in Central Alaskan Yup’ik). Abductive reasoning is a mode of inference represented as below, where the conclusion $p$ is derived from premises $p \rightarrow q$ and $q$.

<table>
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<th>Abduction</th>
<th>Deduction (for comparison)</th>
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<td>$p \rightarrow q$</td>
<td>$p \rightarrow q$</td>
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<tr>
<td>Minor premise:</td>
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<td>$p$</td>
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<tr>
<td>Conclusion:</td>
<td>$p$</td>
<td>$q$</td>
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</table>

Abductive reasoning is often called ‘inference to the best explanation’ in the sense that the conclusion best explains why the minor premise is true. Therefore, the argument of Takubo (2009) and Krawczyk (2012) can be paraphrased as the requirement that the prejacent of indirect evidentials must be the best explanation for why the evidence proposition is true.

Davis and Hara (2014) argue that *yooda* is only felicitous if the event described in its prejacent causes the evidence event. They give the following semantics to *yooda*:

\[
\begin{align*}
\text{Let } s \text{ be the semantic type of events/situations:} \\
\text{a. } [\text{yooda}]^a = \lambda p(u, v). \text{PERCEIVE}(a, e) \land \exists q(e) \land \text{CAUSE}(p, q).
\end{align*}
\]

The \text{PERCEIVE} relation is responsible for the indirectness, or more precisely, the manner of acquisition of *yooda*. Because of this component, *yooda* is incompatible with some cases where the speaker directly perceives the evidence. *(5c)*, which requires the prejacent event to cause the event described by the evidence proposition, thus derives the contrast in *(1)*.

\[\text{CAUSE}(p, q) \text{ is true iff for some } c \text{ in } p \text{ and some } e \text{ in } q, c \text{ causes } e.\]

(Davis and Hara, 2014: 191)

\[\text{(Davis and Hara, 2014: 191)}\]

In addition to the presence of the \text{CAUSE} relation, Davis and Hara (2014) argue that the use of *yooda* does not imply that the speaker is committed to the truth of the prejacent, and, therefore, that no modal component is involved in *yooda*. Although I do not agree with some of the judgments they present, Davis and Hara show statistical evidence for this claim. I will not commit to this issue, but will instead focus solely on whether their causal component is empirically appropriate.
Both the abductive and causal approaches straightforwardly derive the contrast in (1). In (1a), the prejacent (it rained) explains why the evidence proposition (there are puddles) is true, and the raining event causes the appearance of puddles. Meanwhile, in (1b), the prejacent (there are puddles) does not serve as an explanation for why the evidence proposition (it is raining) is true, nor the prejacent event (the appearance of puddles) causes the rain.

Winans (2016) proposes a linguistic diagnostic for the presence (or absence) of the explanation/causation relation, although Takubo (2009), Krawczyk (2012), and Davis and Hara (2014) do not employ it. Let \( p \) and \( q \) be the prejacent and the evidence proposition, respectively. Then, \( p \) explains/causes \( q \) if Because \( p \) can serve as an answer to the question “Why is \( q \) true?”. Employing this test, we can say that the prejacent successfully explains/causes the evidence proposition in (1a), while it does not in (1b). This is illustrated in the following, where (6a) and (6b) test the availability of the explanation/causation relation in (1a) and (1b), respectively:

(6) a. A: Why are there puddles?
   B: Because it rained.

   b. A: Why is it raining?
   B: #Because there are puddles.

Note that Davis and Hara (2014) criticize the abduction analysis in Takubo (2009), claiming that symbolic abduction as in (4a) cannot explain examples in which the prejacent and the evidence proposition are related with a bi-conditional, as in the following. In Vancouver, the sign “Bus Full” appears on the front screen of a bus only if the bus is full. Otherwise, it displays the destination. Therefore, we have the bi-conditional \([a \text{ bus is full } \leftrightarrow it \text{ displays “Bus Full”}]\). This makes the following two forms of abductive reasoning available:

(7) a. Major premise: If a bus is full, it displays “Bus Full”.
    Minor premise: A bus is displaying “Bus Full”.
    Conclusion: That bus is full.

   b. Major premise: If a bus displays “Bus Full”, then it is full.
    Minor premise: A bus is full.
    Conclusion: That bus is displaying “Bus Full”.

Under symbolic abduction analysis, which requires the prejacent to be the conclusion of abduction, the availability of these two directions predicts that both (8a) and (8b) should be acceptable, contrary to the facts.

(8) a. (From outside of a bus, you see the “Bus Full” sign. You say:)
   i) Apparently that bus is full.
   ii) It seems that that bus is full.
   iii) Ano-basu-wa ippai-no yooda.
        that-bus-TOP full-COP yooda
        ‘It seems that that bus is full.’

b. (You are in a bus which is full of passengers. You say:)
   i) #Apparently the “Bus Full” is being displayed.
   ii) #It seems that the “Bus Full” is being displayed.
   iii) #Basu-ga-ippai-no hyoozi-ga de-tei-ru yooda.
        bus-NOM-full-GEN-sign-NOM appear-PROG-PRES yooda
        ‘It seems that the “Bus Full” sign is being displayed.’
In (8a), the prejacent and evidence proposition are that bus is full and the “Bus Full” is being displayed, respectively. The availability of the abductive reasoning in (7a) is compatible with the felicity of (8a). On the other hand, the prejacent and evidence proposition are reversed in (8b). The symbolic abduction in (7b) is also available, which should make (8b) felicitous, although it is not.

However, unlike Takubo (2009), Krawczyk (2012) does not employ symbolic abduction, instead postulating that the prejacent must explain the evidence proposition (in other words, she employs the primitive explain). Consequently, the contrast in (8) is not problematic for the abductive approach, because only (8a) survives Winans’s (2016) test as in the following:

(9) a. A: Why is the “Bus Full” being displayed on that bus?
   B: Because that bus is full.

   b. A: Why is the bus full?
   B: #Because the “Bus Full” is being displayed on it.

Therefore, the abductive approach that relies on the notion of explain accounts for the (in)felicity of the examples in (8), even though the analysis with symbolic abduction cannot distinguish between them. This means that the empirical coverage of the abductive approach is the same as that of the causal one proposed by Davis and Hara (2014).

There are several examples that both the abductive and causal analyses wrongly exclude. First, consider the following example:

(10) (When you come home, your husband phones you and asks if your daughter Mary is home. You hear Mary singing from her room. You say to your husband:)
    a. Apparently she is home.
    b. It seems that she is home.
    c. Kanojo-wa ie-ni iru yooda.
       she-NOM home-in be yooda
       ‘It seems that she is home.’

The prejacent is she (Mary) is home, and the evidence proposition is Mary is singing in her room. The abductive approach claims that Mary being home must explain why she is singing in her room, and the causal analysis requires the Mary-being-home event to be the cause of the Mary-singing event. Intuitively, these do not hold without special contextual settings, e.g. Mary loves singing but is a very shy person who cannot sing outside. However, such a special characterization of Mary is not needed in order for the three evidentials to be used here. Furthermore, this example does not pass Winans’s (2016) test:

(11) A: Why is Mary singing in her room?
    B: #Because she is home.

The second counterexample is the one in which the prejacent accompanies a circumstantial modal:

(12) (You go to a vacant lot to play baseball, but you find other people occupying it. You say to yourself:)
    a. Apparently I can’t use this vacant lot.
    b. It seems that I can’t use this vacant lot.
c. Kono-akiti-wa tuka-e-nai yooda
   this-vacant.lot-TOP use-can-NEG yooda
   ‘It seems that I can’t use this vacant lot.’

The prejacent and the evidence proposition are *I can’t use this vacant lot* and *others are occupying the vacant lot*, respectively. The prejacent does not explain why there are other people in the vacant lot, nor the prejacent event causes the evidence; rather, the opposite direction of explanation/causation seems to hold. Nevertheless, the evidentials are felicitous in (12). As expected, (12) does not pass Winans’s test:

(13) A: Why are others occupying the vacant lot?
    B: #Because I/you can’t use it.

Thus, the felicity of the evidentials in (10) and (12) is problematic in terms of both the abductive analysis (Krawczyk, 2012) and the causal analysis (Davis and Hara, 2014).

2.2.1. The temporal approach

Hirayama (to appear) deals with *yooda*, arguing that a temporal analysis is superior to the causal analysis proposed by Davis and Hara (2014) because it accommodates examples in (10) and (12), while also capturing the contrast in (1). Specifically, Hirayama (to appear) proposes that the initial moment that the prejacent becomes true, i.e., \( \text{EARLIEST}(p) \), comes at least as early as the initial moment that the evidence proposition becomes true (henceforth, \( \text{EARLIEST}(q) \)).

Extending this idea to *apparently* and *seem*, the semantics proposed by Hirayama (to appear) is formalized as in the following:

(14) Let \( q \) be the contextually salient proposition.

a. \( \text{[apparently/seem/yooda]}(p)(w) \) is defined only if \( \exists e[q(e) \land \text{PERCEIVE}(e_S, e) \land \text{EARLIEST}_w(p) \leq \text{EARLIEST}_w(q)] \) (\( e_S \) represents the speaker of the utterance).

b. \( \text{EARLIEST}_w([p]) \) is defined only if \( \{t: [p](t)(w')\} \) has a left boundary \( t' \) (be it open or closed) for some \( w' \) maximally similar to \( w \) (cf. Beaver and Condoravdi (2003)). If defined, \( \text{EARLIEST}_w([p]) = \omega m \in t' \land m \leq \text{LEFTMOST}(t') \).

The \text{PERCEIVE} relation is interpreted in the same way as Davis and Hara (2014). The third conjunct in (14a) says that the earliest moment of the temporal denotation of the prejacent \( p \) must not come later than that of the evidence proposition \( q \). The existential quantification of a maximally similar world \( w' \) in (14b) is postulated because otherwise the proposition embedded under the \text{EARLIEST} operator would be instantiated in the actual world (or more precisely, the evaluation world), and, as a result, the evidentials would be veridical.

Let us see how the definedness condition in (14a) captures the data presented so far. First, consider (1). It is part of our knowledge that rain precedes appearances of puddles. In (1a), the evidentials require that \( \text{EARLIEST}(p) \) (the moment it started to rain) come no later than

---

3This \text{EARLIEST} operator deviates from the traditional formulation in Beaver and Condoravdi (2003) and von Stechow (2009), among others. It avoids the undefinedness that occurs when a proposition with a quantificational past tense is embedded under the traditional \text{EARLIEST} operator (according to Sharvit, 2014) by referring to the left boundary of the temporal denotation of the prejacent.
EARLIEST(q) (the moment puddles appeared). This is compatible with our knowledge. In (1b), on the other hand, they require the opposite temporal relation: the appearance of puddles is required to occur at the same time as, or prior to, the moment it started to rain, which goes against our knowledge, hence (1b) is infelicitous.

Next consider the example of buses in Vancouver, that is, those of bi-conditionals. The “Bus Full” sign is never displayed before the bus becomes full, which is consistent with (8a), where EARLIEST(p) (the moment that the bus got full) must not be anterior to EARLIEST(q) (the moment that the sign appeared). However, (8b) is incompatible with our knowledge of buses in Vancouver; EARLIEST(p) is the moment that the sign appeared on the front screen. It is inevitably preceded by EARLIEST(q), that is, the moment the bus becomes full. Therefore, (8b) cannot satisfy the temporal restriction in (14a).

The temporal restriction in (14a) accommodates cases in which abductive/causal reasoning does not hold. Specifically, in (10), where the prejacent is she (Mary) is home, EARLIEST(p) is the moment she came home. This moment necessarily precedes EARLIEST(q), that is, the moment she started singing in her room. As such, the temporal restriction is satisfied.

The prejacent in (12) contains a circumstantial modal can. Given that the context does not refer to Mary’s permanent ability, the prejacent becomes true when both the facts available at the utterance situation and what is normally true jointly entail that she does not use the vacant lot. Formally, following the standard Kratzerian framework, the truth of the prejacent in (12) is determined relative to the modal base and the ordering source. Since can is a circumstantial modal, the relevant modal base is a fact-based one, as in (15b). I assume that the relevant ordering source is that of normality, as in (15c), because the utterance in (12) does not refer to the speaker’s physical ability nor to any rules or laws in the actual world (that is, the ordering source relevant in (12) seems to be neither ability-based nor deontic). Thus, (15a) represents the truth-condition of the prejacent in (12).

(15) a. \[ I \text{ cannot use this vacant lot} = \lambda t . \lambda w . \forall w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \rightarrow I \text{ don't use the vacant lot at } t \text{ in } w' \right]. \]
   b. \( f(w) = \{ p : p \text{ describes a fact at } t \text{ in } w \} \).
   c. \( g(w) = \{ p : p \text{ is what is normally true in } w \} \).

(15a) says that the prejacent becomes true at an interval \( t \) in a world \( w \) iff the speaker does not use the vacant lot in all worlds that: i) are compatible with the facts available at \( t \) in \( w \), and ii) are best-ranked in terms of normality in \( w \). We normally assume that one does not use a place if others occupy it, so \( g(w) \) contains this proposition. In (12), others are actually occupying the vacant lot, so \( f(w) \) contains the proposition others are occupying the vacant lot. Therefore, the proposition I do not use the vacant lot is true in all worlds in which these two propositions are both true. Assuming that the truth of the propositions describing normality does not hinges on time, i.e., that the propositions in \( g(w) \) do not vary with the utterance time,

\[ \lambda t . \lambda w . \exists w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \land p(t)(w') \right]. \]

\[ \lambda t . \lambda w . \neg \exists w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \land p(t)(w') \right] = \lambda t . \lambda w . \forall w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \rightarrow \neg p(t)(w') \right]. \]

The universal quantification in this formula arises due to the combination of the existential quantification by can and negation:

(i) a. \[ \text{can } p = \lambda t . \lambda w . \exists w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \land p(t)(w') \right]. \]
   b. \[ \neg \text{can } p = \lambda t . \lambda w . \neg \exists w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \land p(t)(w') \right] = \lambda t . \lambda w . \forall w' \left[ w' \in \text{MAX}_g(w)(\bigcap f(t)(w)) \rightarrow \neg p(t)(w') \right]. \]
(15) becomes true when the evidence proposition *others are using the vacant lot* is available. In other words, \textsc{earliest}(p) corresponds to the initial moment that the evidence proposition is true, that is, \textsc{earliest}(q). Since the temporal restriction in (14a) allows the two moments to be simultaneous, it derives the felicity of (12).

However, the temporal analysis is too weak and cannot capture the deviance of the following example:

(16) (You hung your laundry outside last night. Today, you wake up and see the roads are flooded. You infer that it rained so much during the night. You say without seeing the laundry you hung yesterday:)\(^5\)
   a. #Apparently the laundry is wet.
   b. #It seems that the laundry is wet.
   c. #Sentakumono-ga nureteiru yooda.
      laundry-NOM wet yooda
      ‘It seems that the laundry is wet.’

In (16), \textsc{earliest}(p) represents the moment that the laundry got wet last night. Given that the evidence proposition is \emph{roads are flooded}, \textsc{earliest}(q) is the moment that the roads got flooded. The former moment precedes the latter (we usually assume that the laundry outside gets watered before the roads are flooded). Therefore, the temporal requirement predicts (16) to be acceptable, contrary to the fact.

Note that the abductive and causal analyses capture the infelicity of (16). We have seen that in cases where abduction/causation hold, the prejacent must be the answer to the question of why the evidence proposition is true. (16) does not survive this test:

(17) A: Why are the roads flooded?
    B: #Because the laundry is wet.

Thus, all of the three previous approaches discussed above possess some empirical problems; the abductive and causal approaches are both too strong in that they exclude (10) and (12), while the temporal approach is too weak because it cannot explain why (16) is bad.

3. Proposal

I propose weakening the requirement in the abductive/causal analysis to accommodate both (10) and (12). Specifically, I argue that the indirect evidentials are also felicitous if no matter how a minimal situation that makes the evidence proposition true is extended, the extended situation contains a minimal situation where the prejacent is true, as well as if the explanation/causation relation holds between the prejacent and evidence proposition.

3.1. Situation semantics

In situation semantics, propositions are evaluated relative to situations, rather than to possible worlds. Situations are parts of possible worlds, and situations that belong to the one and the same world are partially ordered by the part-whole relation, which I will represent with \(\sqsubseteq\).

\(^5\)I would like to thank Sanae Tamura (p.c.) for bringing up this context.
According to Kratzer (2012), a situation may contain thin particulars and universals (cf. Armstrong, 1978). As far as this paper is concerned, universals can be understood as properties or relations whose domain is that of individuals. A thin particular is whatever is left when we mereologically subtract the universals a particular instantiates (on the other hand, thick particulars are particulars together with the universals they instantiate). For example, there is a part of the world, i.e., a situation, that consists of John’s thin particular and the property of being hungry that the thin particular instantiates. In this situation, the proposition that the individual is hungry is true. A situation does not necessarily contain all the universals instantiated by the particulars contained in that situation.

With these settings, we can define a part-whole relation between two situations:

\( s \) is a part of \( s' \), represented as \( s \sqsubseteq s' \), iff \( s \) and \( s' \) are parts of the same possible world, and \( s' \) contains all the thin particulars \( s \) does, instantiating all the properties and relations that they instantiate in \( s \).

(Adapted from Elbourne, 2013: 24)

Consider the following two situations. The first contains only John’s thin particular and the property of being hungry that is instantiated by John. The second contains only John’s thin particular and the properties of being hungry and tired both of which John instantiates. In this case, the first situation is a part of the second, according to (18). If \( s \subseteq s' \), \( s' \) is often referred to as an extension of \( s \). If \( s \sqsubseteq s' \) and \( s' \) contains some additional elements (that is, \( s \not\sqsubseteq s' \)), \( s \) is a proper part of \( s' \), and is represented as \( s \sqsubset s' \).

The notion of minimal situations will be relevant in the following discussion. A minimal situation is defined relative to a proposition. If a situation \( s \) is a minimal situation for \( p \), then \( p \) is true in \( s \) and \( s \) contains the smallest possible number of thin particulars, properties and relations that make \( p \) true. In other words, there is no situation in which \( p \) is true and which is also a part of \( s \):

\[
\text{(19) } \text{MIN}(p) = \{s : p(s) \land \forall s' [p(s') \land s' \sqsubseteq s \rightarrow s' = s]\}.
\]

(Adapted from Fintel, 1994: 18)

To use Elbourne’s (2013) example, a minimal situation in which John owns Flossy contains only their thin particulars and the relation of owning instantiated by them; no other particulars or universals involved.

Finally, note that a possible world is itself a situation, since \( s \) is a situation in a world \( w \) if and only if \( s \sqsubseteq w \), and \( w \sqsubseteq w \). Following Kratzer (2012), I use \( w_s \) to refer to the world of a situation \( s \); that is, the world of which \( s \) is a part. Given that worlds are situations, I use a semantic type \( s \) for situations including worlds.

3.2. Proposal: the extension requirement

Henceforth, I refer to prejacent/evidence situations as situations in which the prejacent/evidence proposition is true. I propose that apparently, seem, and yooda are also licensed if any extension of minimal evidence situations contains some minimal prejacent situation. I call this requirement the extension requirement.

The extension requirement, given the prejacent \( p \), the evidence proposition \( q \), and a situation \( s \),
represented as $\text{EXT}(p, q, s)$, is spelled out as below:\(^6\)

\[(20)\quad \text{EXT}(p, q, s) = 1 \text{ iff } \forall s', s''[s' \in \text{MIN}(q) \wedge s' \sqsubseteq s'' \sqsubseteq w'] \rightarrow \exists s'''[s''' \in \text{MIN}(p) \wedge s''' \sqsubseteq s'''] \text{ for some } w'.\]

With this definition, I propose the semantics of the indirect evidentials as in (21). I tentatively adopt the explanation requirement (i.e. Krawczyk’s (2012) proposal) for the sake of simplicity, and it should be noted that I stay neutral whether the abductive analysis is empirically superior to the causal one.

\[(21)\quad \text{Let } q \text{ be a contextually salient proposition.}^7\]
\[\text{a. } \text{[apparently / seem / yooda]}^\circ(p)(s) \text{ is defined only if } q(s) \wedge \text{PERCEIVE}(a, s) \wedge [\text{EXP}(p, q, s) \vee \text{EXT}(p, q, s)].\]
\[\text{b. } \text{EXP}(p, q, s) = 1 \text{ iff why } q(s) \text{ is explained if } p(w_i) \text{ is true.}\]

First, the evidence proposition $q$ must be true (that is, $q(s)$) because the speaker observes an instantiation of $q$. Both this and the PERCEIVE relation (as in Davis and Hara, 2014) guarantee that $q$ is the evidence proposition. As is seen in the disjunction, the prejacent $p$ and the evidence proposition $q$ of the evidentials must fulfill at least one of $\text{EXP}(p, q, s)$ and $\text{EXT}(p, q, s)$.

In order to show that the proposed semantics correctly accounts for all the data presented so far, I have to demonstrate that it rules out examples that the abductive approach does (i.e., (1b), (8b) and (16)), while also showing that it accommodates felicitous examples that the abductive approach does not ((10) and (12)); in other words, below we need not address examples that are ruled in under the abductive approach, because such examples satisfy $\text{EXP}(p, q, s)$, so whether or not they are consistent with $\text{EXT}(p, q, s)$ does not have to be examined. I will illustrate that the infelicitous examples fulfill neither $\text{EXP}(p, q, s)$ nor $\text{EXT}(p, q, s)$, and that felicitous examples that the abductive analysis wrongly predicts to be bad are compatible with $\text{EXT}(p, q, s)$.

Let us begin with (1b), repeated here as (22):

\[(22)\quad \text{(You see falling raindrops from the window:)}\]
\[#\text{Apparently there are puddles.}\]

As we saw above, this case does not satisfy $\text{EXP}(p, q, s)$; the prejacent there are puddles cannot be an explanation for why the evidence proposition, it is raining, is true. Furthermore, neither does it not satisfy $\text{EXT}(p, q, s)$. In this example, $\text{EXT}(p, q, s)$ requires that any extension of any minimal situation that makes it is raining true must contain a minimal situation in which there are puddles is true. In this case, there must be puddles in all situations that contain any minimal situation in which it is raining. What is contained in a minimal situation in which it is raining is a certain number of raindrops and the property of falling instantiated by them. A situation has to contain at least a puddle in order to make the prejacent there are puddles true. Therefore, there can be some situations that are extensions of a minimal evidence situation but do not contain a minimal prejacent situation. Consequently, (22) defies the extension requirement.

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\(^6\)As with the EARLIEST operator in Hirayama (to appear), existential quantification over maximally similar worlds is postulated to capture the non-veridicality of the evidentials.

\(^7\)I do not commit to the assertive components of these evidentials.
A similar reasoning applies to the infelicity of (8b), which is repeated below as (23):

(23) (You are in a bus which is full of passengers. You say:)
#Apparently the “Bus Full” is being displayed.

Abductive analysis that does not rely on symbolic abduction correctly rules out this example; it defies EXT\((p, q, s)\) since the appearance of the sign does not explain why the bus is full. Furthermore, EXT\((p, q, s)\) is also not satisfied here. In this case, a minimal evidence situation contains only the bus’s front screen displaying “Bus Full.” Meanwhile, a minimal prejacent situation contains the entire bus and passengers on it (and the relation be full of instantiated by them). The EXT\((p, q, s)\) requires that a minimal situation where the bus is full is contained in any extension of any minimal situation where the bus displaying “Bus Full”. However, situations that are not so large as to contain the entire bus cannot contain a minimal prejacent situation. As such, EXT\((p, q, s)\) does not hold in (23) due to the existence of such situations.

Likewise, the oddity of (16), repeated below as (24), follows straightforwardly.

(24) (You hung your laundry outside last night. Today, you wake up and see the roads are flooded. You infer that it rained so much during the night. You say without seeing the laundry you hung yesterday:)
#Apparently the laundry is wet.

Even if the prejacent is true, that is, if the laundry is wet, it does not explain why the evidence proposition (the roads are flooded) is true. Therefore, (24) is incompatible with EXP\((p, q, s)\). It is also incompatible with EXT\((p, q, s)\). A minimal evidence situation only contains (relevant parts of) the roads and the property of being flooded. Some situation that is an extension of a minimal evidence situation does not have to contain a minimal prejacent situation, which makes the laundry is wet true; a situation is minimally required to contain the laundry and the property of being wet to make such a proposition true. Therefore (24) violates both EXP\((p, q, s)\) and EXT\((p, q, s)\).

Next, let us turn to felicitous examples that the abductive analysis wrongly excludes (i.e., (10) and (12)) by demonstrating that they are all incompatible with EXP\((p, q, s)\), but satisfy the containment requirement. First, recall that the abductive analysis (as well as the causal one) rules out (10), repeated here as (25).

(25) (When you come home, your husband phones you and asks if your daughter Mary is home. You hear Mary singing from her room. You say to your husband:)
Apparently she is home.

As we saw in the previous section, this example does not satisfy EXP\((p, q, s)\), because it does not passes Winans’s test: the prejacent cannot be an answer to the question why the evidence proposition is true. Thus, the felicity of (25) is obtained only if it fulfills EXT\((p, q, s)\), and here it does. A crucial difference between the cases that does not satisfy EXT\((p, q, s)\) and (25) is that in the former cases, the prejacent is not true in a minimal evidence situation. In (25), a minimal evidence situation is a situation where Mary is singing in her room. This makes the prejacent (Mary is home) true, because we just need (the thin particular of) the individual Mary, the relevant part of her home, and the relation of existing-in instantiated by the two entities in order to make that proposition true. In this case, all the three components are contained in
a minimal evidence situation, which automatically fulfills \(\text{EXT}(p, q, s)\) due to persistence of propositions assumed by Kratzer (2012):

\[(26)\] A proposition \(p \in P(S)\) is persistent iff \(\forall s, s' \in S[s \sqsubseteq s' \land p(s) \rightarrow p(s')]\), where \(P(S)\) is the power set of the set of all possible situations \(S\) (i.e., \(P(S)\) is the set of all propositions).

(Kratzer, 2012: 120)

This definition says that if a persistent proposition \(p\) is true in a situation \(s\), it is true in all extensions of \(s\). I assume, following Kratzer, that all propositions are persistent.\(^8\) With this assumption, the prejacent becomes true in all extensions of evidence situations, because, once it is true in a minimal evidence situation, its persistence guarantees that it becomes true in all situations of which the minimal evidence situation is a part. Given persistence, if the prejacent is true in a situation, it means that the situation contains a minimal prejacent situation. Thus, \(\text{EXT}(p, q, s)\) is satisfied in (25), and the semantics proposed in (21) correctly predicts (25) to be felicitous.

Finally, the proposed semantics can capture the felicity of (12), where the prejacent accompanies the circumstantial modal can:

\[(27)\] (You go to a vacant lot to play baseball, but you find other people occupying it. You say to yourself:)

\[
\text{Apparently I can’t use this vacant lot.}
\]

We have seen that abductive analysis (as well as causal analysis) cannot explain the felicity of (27), because the fact that there are others occupying the vacant lot cannot be explained even if the speaker cannot use it (and (27) does not pass Winans’s test). Therefore, (27) is incompatible with \(\text{EXP}(p, q, s)\), and we have to prove that it fulfills \(\text{EXT}(p, q, s)\).

Since our current discussion is based on the framework of situation semantics, I relativize the denotation of the prejacent with possible worlds (that is, (15)) to the one with situations as follows (I ignore the time variable here for expository purposes):

\[(28)\]

\[
a. \quad [I \text{ cannot use this vacant lot }] = \lambda s. \ \forall s' [s' \in \text{MAX}_{f(s)}(\bigcap f(s)) \rightarrow I \text{ don’t use this vacant lot in } s'].^9 \\
b. \quad f(s) = \{p: p \text{ is a relevant fact in } s\}. \\
c. \quad g(s) = \{p: p \text{ is normally true in } s\}.
\]

Therefore, the quantificational domain of can, that is, \(\bigcap f(s)\), represents the set of situations that are compatible with the facts in \(s\) (that is, situations in which all relevant facts in \(s\) are available). Given this, (28a) is true in a situation \(s\) if and only if the proposition \(I \text{ don’t use the vacant lot}\) is true in all the situations that are compatible with all the facts in \(s\), and which are best-ranked in terms of what is normally true in \(s\). When \(f(s)\) contains the proposition others are occupying the vacant lot, the truth of (28a) in \(s\) minimally requires \(g(s)\) to contain a proposition such as if

\(^8\)This assumption might appear to run counter to the semantics of sentences with universal quantifiers; even if all the people in Japan have the property of living in Japan, it does not ensure that all the people in the world have this property. This problem can be circumvented with contextual restrictions on quantificational domains (cf. von Fintel, 1994). For more details, see Section 5.3.4 of Kratzer (2012).

\(^9\)This denotation is somewhat simplified compared to those proposed in Portner (2007) and Kratzer (2019), where modals are treated similarly to quantificational adverbs. I redact such a complication because it is not relevant to the current discussion.
someone occupies a place, then you do not use it, because these two propositions jointly entail that the speaker does not use the vacant lot.

What fact is available depends on the situation, so the output of the modal base $f$ varies with the input situation. However, what is normally true depends on what possible world we are talking about, and it seems unproblematic to assume that what is normal does not vary among situations that belong to the same world, especially when it comes to conditionalized propositions such as if someone occupies a place, then others do not use it. Suppose that this proposition is normally true in some place that is a part of this world. It is not conceivable if that proposition loses its normality in another part of the same world. That is, some of the propositions that are normally true in a situation are also normally true in any part of the same world. I refer to such propositions as situation-independent propositions, whose formal definition is provided in (29):

$$\forall s', q[[s' \sqsubseteq w; s' \notin \text{MIN}(q)]] \rightarrow p \in g(s').$$

In prose, if a situation-independent proposition is contained in the ordering source in $s$, then it is also contained in the ordering source whatever non-minimal situation (in the same world) it takes. The non-minimal requirement is needed because if $p$ were normally true in minimal situations as well, minimal situations would no longer be minimal; such minimal situations would make it true that normally $p$ is true. I assume that, at the very least, conditionalized propositions in $g(s)$ are situation-independent.

Let us see how both the definedness condition in (28a) and situation-independence satisfy the extension requirement. In (27), the evidence proposition $q$ is others are occupying the vacant lot. This proposition is true in all situations $s''$ such that for all $s' \in \text{MIN}(q)$, $s'$ is a part of $s''$ because of persistence. This means that for all such situations $s''$, $f(s'')$ contains $q$. Consequently, (20) in (12) winds up saying that a minimal situation in which the proposition I cannot use the vacant lot is true is contained in all situations (in the same maximally similar world) where others are occupying the vacant lot.

Here, the situation-independence of conditionalized propositions comes into play. The proposition if someone occupies a place, then you do not use it is normally true in our world, so it should normally be true in any maximally similar worlds. (29) ensures that this conditional proposition is contained in the set of normal propositions relative to all non-minimal situations in those worlds. Therefore, for all $s''$ such that $s' \sqsubseteq s''$ for all $s' \in \text{MIN}(q), f(s'')$ at least contains the proposition others are occupying the vacant lot, and $g(s'')$ at least contains if someone occupies a space, then you do not use it (the requirement $s' \sqsubseteq s''$ ensures that $s''$ is non-minimal, which means that the situation-independent proposition is a member of $g(s'')$). We have seen that the truth of (28a) minimally requires these two propositions to be true. Therefore, no matter how a minimal evidence situation $s'$ is extended to a larger situation $s''$, there is some minimal prejacent situation that is contained in $s''$, because both $f(s'')$ and $g(s)$ at least contain others are occupying the vacant lot and if others are occupying a place, then you don’t use it, respectively. This fulfills EXT($p, q, s$).
4. Conclusion and prospects

It was shown that some evidentials put a semantic restriction on what information can count as evidence, in addition to their evidence-type specification. I examined the empirical coverage of previous studies, demonstrating that all of them run counter to problematic examples. I proposed weakening the abductive/causal analysis in Krawczyk (2012) and Davis and Hara (2014) with the extension requirement, and illustrated that the proposed semantics correctly derives the (in)felicity of all the examples discussed so far.

While the proposed analysis is empirically superior to previous analyses, it has still a conceptual drawback: previous analyses (that is, the abductive, causal, and temporal ones) attempt to derive the facts with one constraint, while the current proposal posits two requirements connected with a disjunction, which is stipulative unless there is a conceptual link between the two disjuncts.

The issue of how to subsume one of the two requirements under the other still persists, but there is a candidate that can be an alternative to the disjunctive constraint: Lewis’s (1973) analysis of causation. Roughly, Lewis’s definition of causation between the cause $c$ and effect $e$ is that if $c$ did not occur, then $e$ would have not occurred. Substituting these two events with propositions instantiated by them, I propose the following counterfactual statement as a possible candidate (Note that although there are a lot of objections to defining causation as in (30), what is needed here does not correspond to the right analysis of causation):

(30)  **Apparently** / **seem** / **yooda** are felicitous where the following statement is acceptable:

\[
\text{if the prejacent were not true, then the evidence proposition would not be true.}
\]

It should be noted that (30) consists of natural language, rather than of formal language, so its interpretation depends on our linguistic intuition.

The following shows that the generalization in (30) is compatible with (in)felicity of the examples we have seen so far:

(31) a. Context: You see puddles on the ground:

   *Apparently* it rained.

   [✓ If it had not rained, then there would not be puddles.]

b. Context: You see falling raindrops from the window:

   #*Apparently* there are puddles.

   [# If there were not puddles, then it would not have rained.]

(32) a. (From outside of a bus, you see the “Bus Full” sign. You say:)

   *Apparently* that bus is full.

   [✓ If that bus were not full, then “Bus Full” sign would not be being displayed.]

b. (You are in a bus which is full of passengers. You say:)

   #*Apparently* the “Bus Full” is being displayed.

   [#If the “Bus Full” were not being displayed, then the bus would not be full.]

(33) (When you come home, your husband phones you and asks if your daughter Mary is home. You hear Mary singing from her room. You say to your husband:)

---

10 Note that Davis and Hara (2014) do not adopt Lewis’s definition of causation; rather, they leave the relation **CAUSE** as a primitive.
Apparently she is home.
[✓ If Mary were not home, then Mary would not be singing in her room.]

(34) (You go to a vacant lot to play baseball, but you find other people occupying it. You say to yourself:)
Apparently I can’t use this vacant lot.
[✓ If I could use this vacant lot, then others would not be occupying it.]

(35) (You hung your laundry outside last night. Today, you wake up and see the roads are flooded. You infer that it rained so much during the night. You say without seeing the laundry you hung yesterday:)
#Apparently the laundry is wet.
[#If the laundry were not wet, then the roads would not be flooded.]

Thus, we do not need to resort to a disjunctive constraint by positing the generalization in (30) as a semantic constraint on the indirect evidentials.

The counterfactual in (30) seems to have a conceptual connection to what is expressed in EXP(p, q, s) and EXT(p, q, s).11 EXP(p, q, s) requires that the prejacent p be the best-fit (or the most plausible) explanation for the evidence proposition q. Formally, it is unclear what it means for a proposition to be an explanation for another. However, we have a strong intuition that an explanandum/causee is not observed if what explains/causes it is unavailable.

As for EXT(p, q, s), we have seen that it is satisfied (i) if a minimal evidence situation itself makes the prejacent true (as in (10), where p = Mary is home and q = Mary is singing in her room), or (ii) if the truth of the prejacent minimally follows from the addition of what is normally true to the information available in a minimal evidence situation (as in (12), where p = I cannot use this vacant lot and q = Others are occupying the vacant lot). In the case of (i), if the prejacent (that is, what is entailed) is false, then the evidence proposition (what entails the prejacent) automatically becomes false. In the case of (ii), it is plausible that propositions that are normally true in the actual world are all actually true in the same world unless otherwise specified (that is, if p is normally true, we assume that p is actually true unless something unexpected happens). This means that if a modalized prejacent is false in the actual world, we ordinarily assume that what is false is not what is normally true, but what is observed (i.e., evidence) on which the modal reasoning is based. Given that such observations are described by the evidence proposition, the falsity of the prejacent, in normal cases, winds up implying that the evidence proposition is not true.13 Thus, we can say that the counterfactual statement in (30) is a plausible candidate to unify the two conditions.

However, the generalization in (30) relies on our intuition regarding a natural language sentence, rather than on the interpretation of formal meta-language. This is undesirable because we cannot see the formal relationship between evidentials’ meaning and other semantic fields

11Lisa Matthewson (p.c.) commented that this counterfactual is acceptable, but not so obvious as the other good ones, as well as that it somehow requires a bit more reasoning.

12This and the next paragraphs do not address a formal relationship between (30) and the two constrains proposed in the previous section. Instead, it provides an intuitive motivation for why the empirical coverage of (30) is identical to that of the disjunctive constraint [EXP(p, q, s) ∨ EXT(p, q, s)].

13Of course, this reasoning does not always hold. This might play a role in the fact that (34) sounds a bit less acceptable than other counterfactuals as is alluded to above.
unless (30) is implemented with familiar semantic toolboxes. Therefore, one avenue for future research is to pursue how to formalize the descriptive generalization in (30).

Finally, given that the proposed semantics is independent of evidence-type specification, it is potentially applicable to evidentials with other evidence-types. In fact, it is compatible with typical direct evidence, which is expressed with the Tibetan direct evidential ‘dug’ (the data are from Kalsang et al., 2013):

(36) a. Visual
   bKra.shis stod.gos sngon po zhig.gyon ‘dug
   Tashi shirt blue a wear ‘dug
   ‘Tashi is wearing a blue shirt (and the speaker sees it).’

b. Auditory
   dKun.dg’as gzas gtang gi ‘dug
   Kunga song sing IPFV ‘dug
   ‘Kunga is singing (and the speaker hears it).’

c. Tactile
   lug gi bal ‘di ‘jam.po ‘dug
   sheep AGT/INST wool this soft ‘dug
   ‘This sheep’s wool is soft (and the speaker feels it).’

d. Gustatory
   ja la tsha min ‘dug
   tea OBL salt NEG ‘dug
   ‘There is no salt in the tea (and the speaker tastes it).’

e. Olfactory
   spos de dri.ma zhim.po ‘dug
   incense this smells good ‘dug
   ‘This incense smells good (and the speaker smells it).’

As is seen in the description of what evidence is, in (36a), (36b), (36c), and (36e), the evidence proposition seems to correspond to the prejacent: in all these examples, the speaker perceives the event instantiating the prejacent (though the ways of perception differ). The extension requirement is satisfied if the prejacent and evidence proposition are identical, because minimal p-situations are contained in (or identical to) all extensions of all minimal situations in which p is true due to persistence. As for (36d), the evidence proposition seems different from the prejacent, because even if one tastes something and finds that it is not salty at all, she cannot know whether there is not salt in it or not; at the very least, we can safely say that the evidence proposition in (36d) is the tea is not salty at all. Although it is not clear whether the extension requirement is met, (36d) satisfies the abductive/causal requirement: the saltlessness of the tea is explained/caused by lack of salt in the tea. Thus, the proposed semantics of evidence can possibly be extended beyond indirect evidentials. Although its applicability is subject to future research, the semantics of evidence beyond evidence-types represents a perspective that has not been pursued by previous studies.

References


A vagueness based analysis of abstract nouns

Halima HUSIĆ — Ruhr-University Bochum

Abstract. The count/mass distinction is a widely discussed topic across languages and linguistic theories have covered a great part of peculiarities which appear in relation to this phenomenon. Abstract nouns have often been left out of consideration, possibly due to the fact that their reference is abstract and the application of some relevant features of count or mass reference, such as cumulativity, divisiveness or atomicity, does not seem to be possible. This paper presents a thorough study of lexical features of a subset of abstract nouns and their distribution in COCA which suggests that countability in abstract nouns has to be determined relative to their semantic category. Focusing on eventuality denoting nominals which comprise a substantial part of abstract nouns, I argue that these nouns resemble concrete nouns in that the countability distinctions are expressed in surprising similarity. I find that the core feature underlying the distinction between abstract count and abstract mass nouns is the vagueness of the minimal components, an approach pursued by Chierchia (2010) for concrete nouns. The minimal components of the count eventualities appear to be stable in all precisifications, unlike those of mass eventualities which are not determined and vary.

Keywords: count/mass distinction, abstract nouns, nominal semantics, corpus study, eventualities.

1. Introduction

Theories that deal with the semantics of nouns, and in particular with the count/mass distinction, have developed dynamic proposals suggesting a set-theoretic modelling of the extension of count and mass nouns by replacing the traditional universe of entities with a more dynamic one which captures entities denoted by singulars, plurals, groups and mass terms (among others Link, 1983; Krifka, 1989; Chierchia, 1998, 2010; Rothstein, 2010, 2017; Landman, 1989, 2010, 2016; Sutton and Filip, 2016). Importantly, these approaches are limited to concrete nouns, for obvious reasons such as that atomicity, contextual as well as natural, or overlap/disjointness as the core notions underlying these theories refer to denotational properties of these nouns, and it is unclear whether and how this can be applied to a set of nouns whose denotation (i) cannot be impinged by the senses, (ii) does not provide a spatio-temporal collocation or (iii) is not imaginable. Nonetheless, abstract nouns do have countability preferences. Some nouns prefer to have a count-like distribution while other occur rather like mass nouns, as illustrated in (1) with knowledge appearing as a mass noun and virtue as a count noun.

(1) a. (...) these people don’t have much knowledge of what’s east of the Appalachians.
   b. One of the many virtues of pumpkins is the ability to combine equally well with sugar and spices or salt (...)

1The development of this paper was colored by several discussions with Gennaro Chierchia, Tibor Kiss, Francis Jeffry Pelletier and Agata Renans to which I am very grateful. I would also like to thank Jenny Doetjes, Hana Filip, David Nicolas, Claudia Roch, Radek Šimík, Malte Zimmermann and Roberto Zamparelli for helpful remarks, Jutta Pieper for technical support with the extraction of corpus data, as well as the audiences in Bochum, Düsseldorf, Annual Meeting of the Berkeley Linguistics Society 44 and Sinn & Bedeutung 24.

2With the mentioned criteria I refer to ways of defining the notion of abstract For a discussion of these criteria I refer to Zamparelli (2019), Rosen (2018) and Asher (1993) among others.

3Unless marked otherwise, all the examples used in this paper are corpus occurrences taken from COCA (Davies,
With abstract nouns, as *knowledge* and *virtue*, I speak of a preference of countability, instead of a clear classification as count or mass, because of the flexibility these nouns provide. While we have observed that concrete nouns shift their countability by certain means easily, such as the Universal Grinder (Pelletier, 1979), Universal Packager (Bach, 1986) or Universal Sorter (Bunt, 1985), or they are ambiguous between a count and mass classification, as cases of dual-life nouns, such as *cake*, *rope* or *stone*, abstract nouns provide an even greater degree of flexibility in this regard. The use of exactly the same nouns addressed in (1) in the following examples illustrates this phenomenon.

(2) a. But as Vice President Quayle said recently, there’s **much virtue** in abstinence and I think that’s something that we, as role models and parents or even extended others, need to really preach to the young people (...)  
b. Boys and girls are being thrust into adulthood without **a knowledge** of their past, something unimaginable a generation ago.

This paper addresses two challenges with regard to the count/mass distinction in abstract nouns: One is the variation among abstract nouns which affects their countability and two is the application of formal semantic theories of the count/mass distinction to abstract nouns. The paper is structured as follows: Section 2 introduces some related work on countability of abstract nouns and presents the challenges that arise in dealing with them. In section 3, I elaborate on my original investigation of a subset of abstract nouns including a manual annotation task and a corpus study in COCA (Davies, 2010). Section 4 summarizes the results of my research and present an analysis for eventuality denoting nominals. In section 5, I discusses directions for further research with abstract nouns.

2. **Background**

Any study of abstract nouns requires a definition of the term *abstract*, as well as a characterization of the distinction between *abstract* and *concrete*. Among the criteria used in philosophy and linguistics to determine the notions *abstract*, Zamparelli (2019) summarizes four approaches to determining the notion *abstract*, which are listed in (3).

(3) Four criteria relevant for defining abstract nouns  
   a. ability to impinge on the senses  
      According to this criterion only concrete nouns denote entities that can be perceived by means of the five senses.  
   b. imageability  
      This way of distinguishing concrete from abstract nouns implies that concrete nouns denote entities which are imaginable.  
   c. morphological derivation  
      In this case, abstract nouns are claimed to be derived nominals, such as nouns ending in *-ness, -ity, -tion or -hood, -itude, -cy, -ment, -ship* for English.  
   d. spatio-temporal collocation  
      This criterion implies that abstract nouns denote entities that do not have a location in space or time

---

4Polikarpov and Kurlov (1994) claim that there is a link between the notion *abstract* and *ambiguity*, according to which the more abstract the nouns denotation is, the greater is the degree of polysemy (cf. Levickij, 2005).
Obviously, there is a great amount of overlap among the nouns addressed by the above presented criteria, as for illustration the noun happiness is morphologically derived, and it is not located in space, perhaps in time though. Happiness can only be imagined by means of a bearer of happiness\textsuperscript{5} or a situation that evokes happiness as e.g. the birth of a baby, but not without additional entities. And, happiness can also not be impinged by the five senses. Yet, many issues are not accounted for by all four criteria, as e.g. fictive objects, such as unicorns, pokemons or dragons, which are definitely imaginable. Another issue are morphologically underived nouns such as joy which do not pass the morphological criterion but all the others.

One of the reasons why abstract nouns are not easy to determine is that this class of nouns is heterogeneous in many ways. Duden (2005) lists nine subclasses of abstract nouns, although they admit that this list is by no means exhaustive, as illustrated in Table (3). With the diversity of abstract nouns in mind, the question arises whether a common semantics underlying these nouns at all is appropriate. Nonetheless, some linguistic research has focused on certain sets of these nouns and their ability to be counted, to which I turn in the next section.

### 2.1. Related Work

Most of the work on abstract nouns and countability has either focused on a specific phenomenon regarding these nouns or study only a subset of abstract nouns, as e.g. nominalizations. However, the topic of nominalizations has gained much interest in linguistic literature, and when it comes to the count/mass distinction, many of these papers need to be considered (among others: Mourelatos, 1978; Alexiadou et al., 2010; Grimm, 2014; Grimshaw, 1990). Mourelatos (1978), for instance, studies the relation between the Aktionsart of a verb and the countability of the resulting nominalization and claims that the nominalizations of verbs denoting states or activities are not countable, whereas nominals from verbs that denote accomplishments or achievements are countable. Another idea put forth by Brinton (1998) implies that the morphological means used to derive a nominal influence the countability of the resulting nominal. Besides, Grimshaw’s seminal work differentiates events (in the nominal domain) with argument structures (Complex Event Nominals - CEN) from those without argument structure and claims that CENs cannot be pluralized. Contrary to that, Alexiadou et al. (2010) claim that the pluralization of CENs (or Argument Supporting Nominals, ASN - as they call them)

\textsuperscript{5}Noun phrases that are headed by abstract nouns and contain additional modifiers that allow the specification of the abstract concept are called tropes. Tropes enable abstract nouns to lose their abstractness by way of referring to a specific instance of the abstract term (cf. Moltmann, 2013; Campbell, 1990; Williams, 1953).

<table>
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<tr>
<th>deadjectival</th>
<th>stupidity, bravery</th>
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<tr>
<td>deverbal</td>
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<td>psych</td>
<td>drama, faith, mercy</td>
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<td>property or quality</td>
<td>honor, humiliation, justice</td>
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<td>fact, thing, point, problem, reason, difference, upshot</td>
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<td>news, message, rumour, report, order, proposal, question</td>
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<td>relational</td>
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<td>measure &amp; time</td>
<td>value, evening, midday</td>
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<td>sciences &amp; arts</td>
<td>surgery, philosophy, linguistics</td>
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Table 1: Diversity of abstract nouns
is subject to cross-linguistic variation, and that the (in)ability to pluralize ASNs relates to aspectual properties, such as (a)telicity, (im)perfectivity and boundedness. Grimm (2014) tested several hypotheses empirically and presents a thorough corpus investigation of count and mass nominalizations. Based on the inference he draws from the corpus study, he claims that none of the hitherto proposed hypotheses regarding the countability of abstract nouns is sufficient. Instead, he argues that the issue need to be approached from certain semantic subclasses, i.e. bodily and mental states, mental and behavioral properties and psych nouns. Another subclass of abstract nouns are nouns derived from gradable adjectives which Nicolas (2003, 2010) analyzes as two-place relations, between an instance of a property, and an individual in which this instance manifests itself. He argues that such abstract nouns resemble mass nouns and thus include measure functions to capture comparative constructions with more and less. Zamparelli (2019) focuses on the ambiguity within abstract nouns and how it relates to a difference in countability. He proposes that in addition to the common universal thought machines of deriving count nouns from mass nouns or vice versa, several additional shifts of meaning and/or countability are needed for abstract nouns.

2.2. The Challenge

Bearing in mind the hitherto work devoted to studying (subsets of) abstract nouns, it seems that the discrepancies and the variation we are familiar with concrete nouns, are even greater in the realm of abstract nouns. The core challenge in identifying countability distinctions in abstract nouns is their high degree of polysemy and flexibility with respect to countability. Consider the following sets of noun senses with assigned countability features taken from BECL 2.1 (Kiss et al., 2016).6

(4) a. access#3 (a way of entering or leaving) COUNT
   b. access#1 (the right to enter) MASS
(5) a. license#1 (a legal document giving official permission to do something) COUNT
   b. license#4 (the act of giving a formal (usually written) authorization) COUNT
   c. license#2 (freedom to deviate deliberately from normally applicable rules or practices (especially in behavior or speech)) state MASS
   d. license#3 (excessive freedom; lack of due restraint) MASS
(6) a. life#3 (the course of existence of an individual; the actions and events that occur in living) COUNT
   b. life#1 (a characteristic state or mode of living) MASS
   c. life#4 (the condition of living or the state of being alive) MASS
(7) a. disappearance #2 (the event of passing out of sight) COUNT
   b. disappearance #3 (gradually ceasing to be visible) MASS
(8) a. humiliation#2 (strong feelings of embarrassment) MASS
   b. humiliation#3 (an instance in which you are caused to lose your prestige or self-respect) COUNT

6The Bochum English Countability Lexicon (BECL) is a lexical resource comprising 7050 English nouns with countability assignments for each sense of the noun. The senses are taken from WordNet (Miller, 1995), and the countability classification is derived through a large-scale annotation task by native speakers of Canadian English. For more details see Kiss et al. (2014, 2016) and the project website http://count-and-mass.org/.
The data in (4)—(8) shows that the countability of these nouns is either underspecified or ambiguous. And this effect derived nominals as well as underived as e.g. licence or life.

3. Empirical Observations

The fact that abstract nouns are indeed flexible with regard to countability is precisely the issue I aim to disentangle. In order to identify the distinctive properties of nouns or noun senses that determine the countability of the nominal, I will study the lexical properties of such nouns by means of a manual annotation process of a subset of abstract nouns in BECL 2.1.

3.1. Lexical Annotation

The subset of BECL which has been used for the annotation process has the following characteristics:

(9) **Constraints on the annotated dataset**

the lexical annotation process is conducted on BECL nouns
- which are polysemous
- one sense of which is count, and one is mass
- one sense of which is abstract according to at least one semantic criterion outlined in (3)

The BECL nouns in (4) — (8) fall within these constraints. The purpose of the annotation process is now to study each sense and annotate relevant notions, features or descriptions that seem to differentiate the count and mass senses of one noun. As an illustration consider the following noun-sense pair:

(10) a. approval#1 the formal act of approving
    event, bounded
    COUNT
    b. approval#2 a feeling of liking something or someone good
    quality, feeling
    MASS

Among the annotation schemes that were at my disposal none was appropriate to capture the discriminating countability features. Thus, for instance, the WordNet Tops did not discriminate count and mass senses. Similarly, the typology of events by (Bach, 1986: 62) or Asher’s schema of types of abstract references (Asher, 1993: 57) could not account for the whole spectrum of the data I aimed to annotate. Hence, the choice of the set of annotations was specified on basis of a first pilot annotation in which I annotated many features freely. The second annotation process was conducted systematically on basis of a closed set of annotations presented in Table 2.

<table>
<thead>
<tr>
<th>annotation</th>
<th>description</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>non-dynamic condition or way of being that is present during a particular time</td>
<td>accord #1 (harmony of people’s opinions or actions or characters)</td>
</tr>
<tr>
<td>process</td>
<td>a particular course of action or a phenomenon that last over time, can be bounded in time or space but does not necessarily have to be</td>
<td>carving#2 (removing parts from hard material to create a desired pattern or shape)</td>
</tr>
</tbody>
</table>
The above presented annotations provide an insight into the types of abstract nouns and their countability assignments. Some of these annotations occur with count senses only, such as instance, place, person or accomplished. Process on the other hand is an annotation which appears only with mass senses. Besides these, other annotations show great tendencies towards one countability assignment. Count senses appear often to be annotated as instances, events and objects, which happen to be concrete sometimes; abstract mass nouns represent rather unbounded entities: qualities, states and processes. This state of affairs implies that aspectual properties might be of relevance for the count/mass distinction.

<table>
<thead>
<tr>
<th>annotation feature</th>
<th>count</th>
<th>mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>8</td>
<td>54</td>
</tr>
<tr>
<td>event</td>
<td>77</td>
<td>4</td>
</tr>
<tr>
<td>quality</td>
<td>3</td>
<td>69</td>
</tr>
</tbody>
</table>

Objects are mostly non-abstract entities. Despite of that, I include them in the annotation process since they present only one specific sense of an abstract noun.

Table 2: Annotation features and their description
Table 3: Distribution of annotations in count and mass senses

Table 3 illustrates the above-mentioned tendencies of certain annotations. The category bounded is predominantly count and very frequent due to the varying interpretation of this category which can be assigned to bounded events but also to objects or place-holders. Besides bounded, the categories event and place-holder tend, too, to be classified as count. The diagram in Figure 1 pictures the distribution of the different categories in count and mass senses.

![Figure 1: Descriptive results of the lexical property annotation](image)

3.1.1. Intra-sense Relations

Inspired by rule-based mechanism to account for certain cases of polysemy, such as regular polysemy,8 (Falkum, 2010) defines a set of regular sense derivations which also capture a difference in countability. Analogous to this, I identify three regular ways of deriving a count sense

8I am following the definition of regular polysemy in (Apresjan, 1974: 16) who identifies it as a reoccurring pattern. For experimental research on the acceptability of certain cases of regular polysemy see Rabagliatii et al. (2011).
from a mass senses in the domain of abstract entities. Taking all the possible derivations into account, it seems difficult to generalize and cover them all under one function. Instead, I will limit my observations to three mass categories, i.e. qualities, states and processes. These three annotations are mostly mass categories but allow count interpretations with modified meanings regularly. The process of deriving these count interpretations from the basic mass meaning can be formalized as follows:

\[(11) \text{ if a noun } X \text{ has a mass sense } a \text{ which denotes a quality, a process or a state:} \]
\[\Rightarrow \text{ then it will have a count sense } b \text{ with one of the possible interpretations:}\]
\[1. \text{bounded process / event (BP)}\]
\[2. \text{instance thereof (IN)}\]
\[3. \text{(itemized) place-holders (IPH)}\]

In these specific shifts, it seems that the derivation has to go from mass to count and not the other way round, because the meanings which are referred to with the mass senses are all more general than the count senses. The count senses describe either modified cases of qualities, states and processes or a specification in which the focus is only on a part or an instance of these processes, states or qualities. I provide examples from BECL for each shift in (12)-(14).

\[(12) \text{ transplant}^2 \Rightarrow_{BP} \text{ transplant}^1\]
\[a. \text{ transplant}^2 \text{ (the act of removing something from one location and introducing it in another location)} \text{ MASS}\]
\[b. \text{ transplant}^1 \text{ (an operation moving an organ from one organism (the donor) to another (the recipient))} \text{ COUNT}\]

\[(13) \text{ hope}^2 \Rightarrow_{IN} \text{ hope}^1\]
\[a. \text{ hope}^2 \text{ (the general feeling that some desire will be fulfilled)} \text{ MASS}\]
\[b. \text{ hope}^1 \text{ (a specific instance of feeling hopeful)} \text{ COUNT}\]

\[(14) \text{ need}^4 \Rightarrow_{IPH} \text{ need}^2\]
\[a. \text{ need}^4 \text{ (a state of extreme poverty or destitution)} \text{ MASS}\]
\[b. \text{ need}^2 \text{ (anything that is necessary but lacking)} \text{ COUNT}\]

3.2. Corpus Study

This section elaborates on certain tendencies of the syntactic distribution of the abstract nouns under consideration using COCA (Davies, 2010). This corpus study targets discriminating occurrences, in particular the use in plural form and in combination with the indefinite article. By means of corpus studies we can only observe certain tendencies of nouns to occur in specific distributions. That some nouns do not appear in a particular context must not be interpreted as if it were ungrammatical in such a distribution. Instead, there might be independent reasons for why certain nouns lack certain distributions, as for instance the specific genre of the corpus, or a small number of total occurrences. The results I will report should, therefore, not be taken as conclusive, but rather as an affirmation or rejection of the generalizations made on basis of the

\[\text{I use the terms bounded process and event synonymously. The difference between processes and events is that process are atelic, and events are terminated, hence telic. Many eventive nouns have a mass sense which focuses on the mere atelic process, and a count sense describing a telic event which includes this specific process, hence the term bounded process, e.g. transplant.}\]
lexical investigation described in the previous section.

The corpus study is conducted on basis of a substantial portion of the COCA corpus (Davies, 2010) provided by the AFM-project\(^{10}\) and parsed with the Stanford Dependency Parser. I further analyzed the data by creating python scripts with the library pandas which extracted certain patterns of occurrences along with distributional information and frequencies.

### 3.2.1. Plurals

Let us first look into the use in plural number. Following the classification of these nouns in BECL, it is expected that all nouns are grammatical in plural use, since they have (at least) one sense which is countable. Yet, the nouns in this dataset do not provide an equal share of the use in plural number. As illustrated with the frequencies in Table 4 and 5, some nouns appear to be very frequent in plural, even more than in singular form, while some other nouns appear in plural rarely.

<table>
<thead>
<tr>
<th>noun</th>
<th>total</th>
<th>plurals</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>access</td>
<td>36800</td>
<td>143</td>
<td>0,39</td>
</tr>
<tr>
<td>camouflaged</td>
<td>1369</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>disintegration</td>
<td>959</td>
<td>7</td>
<td>0,73</td>
</tr>
<tr>
<td>fill</td>
<td>1750</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>presence</td>
<td>29633</td>
<td>198</td>
<td>0,67</td>
</tr>
<tr>
<td>salvation</td>
<td>4070</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>survival</td>
<td>11962</td>
<td>47</td>
<td>0,39</td>
</tr>
<tr>
<td>synchronization</td>
<td>301</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>unfairness</td>
<td>385</td>
<td>2</td>
<td>0,52</td>
</tr>
<tr>
<td>vindication</td>
<td>432</td>
<td>3</td>
<td>0,69</td>
</tr>
</tbody>
</table>

Table 4: Low frequencies in plural form

<table>
<thead>
<tr>
<th>noun</th>
<th>total</th>
<th>plurals</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>marking</td>
<td>1026</td>
<td>1013</td>
<td>98,73</td>
</tr>
<tr>
<td>ruin</td>
<td>3566</td>
<td>3373</td>
<td>94,59</td>
</tr>
<tr>
<td>constraint</td>
<td>6208</td>
<td>5096</td>
<td>82,09</td>
</tr>
<tr>
<td>expectation</td>
<td>8959</td>
<td>7284</td>
<td>81,3</td>
</tr>
<tr>
<td>skill</td>
<td>52840</td>
<td>40819</td>
<td>77,25</td>
</tr>
<tr>
<td>aspiration</td>
<td>4410</td>
<td>3380</td>
<td>76,64</td>
</tr>
<tr>
<td>consequence</td>
<td>21500</td>
<td>15496</td>
<td>72,07</td>
</tr>
<tr>
<td>fatality</td>
<td>1262</td>
<td>834</td>
<td>66,09</td>
</tr>
<tr>
<td>resource</td>
<td>54918</td>
<td>36155</td>
<td>65,83</td>
</tr>
<tr>
<td>remark</td>
<td>7997</td>
<td>5235</td>
<td>65,46</td>
</tr>
</tbody>
</table>

Table 5: High frequencies in plural form

Comparing the nouns in these two tables does not give a straightforward explanation as to why these nouns have such different distributions, since in both groups we have eventive nouns and nouns that are morphologically derived as well as underived (or zero-derived), such as fill or skill. However, if we look into specific occurrences of these nouns, we will observe that we find much more lexicalized meanings of the event’s result in Table 5, such as ruins (15b) or markings (15a):

\begin{enumerate}
\item Even if the graffitists are the least dangerous of these, their ever-present \textbf{markings} serve to persuade the passenger that, indeed, the subway is a dangerous place.
\item The classical \textbf{ruins} at Mantinea lie in a field next to a weird modern Orthodox church, which looks like a Red Grooms version of the Venetian Gothic cathedral at Torcello.
\end{enumerate}

In addition to these rather concrete uses of abstract nouns, one can also find cases which I describe as (itemized) place-holders in (11) where the use of the abstract noun refers to an

\(^{10}\)AFM - \textit{Accounting for the Foundation of Mass} is funded by the Alexander-von-Humboldt-Foundation (AvH). One of the greatest contributions of this project is the development of an English sense-based lexicon with countability assignments, http://count-and-mass.org/.
entity which is true of that predicates. It thus functions as a place-holder for another entity, which can then be an object, or an event or a proposition. Consider as an illustration the following examples:

(16)  a. Many regard graduate school not simply as the place to acquire a certain level of knowledge and proficiency in a field but as an open-ended status where the aspiring Ph.D. can sit and “mellow” (like a wine?), “ripen” (like a cheese?), and “grow” (like a vegetable?) – the organic metaphors flourish in the prose of departments seeking more time and support for their students. These expectations were explicit in Irving Babbitt’s opposition of Germanic “specialization” to the more “humane” growth as a man.

b. If, in the hierarchy of values held by the academic community of which one is a part, the value of freedom of inquiry is higher than the value of equality (the value that gives rise to conspicuous benevolence), then such constraints, such self-suppression of research into inconvenient questions, will no longer be effective.

c. She was glad she’d had enough warning to hide a few embarrassments: stuffed animals, posters showing kittens and cloying sentiments about love.

3.2.2. Indefinite Article

The indefinite article is - next to plural number - one of the signature characteristics of count nouns (cf. for instance Payne and Huddleston, 2002). In sum, the nouns under consideration do not appear that frequent with the indefinite article, since the average occurrence with the indefinite article lies at 8.59%. Below, I will discuss the most peculiar cases.

Ruin and marking are nouns which occur much more often in plural use, and their distribution with the indefinite article is accordingly very low. In Table 7 we observe again cases such as copy (17) which provide a highly lexicalized meaning as the resulting object, which resembles the count uses of marking and ruin.

(17) Before my trip my father handed me a copy, but added a critique of his own literary style.

<table>
<thead>
<tr>
<th>noun</th>
<th>total</th>
<th>indefs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>access</td>
<td>36800</td>
<td>203</td>
<td>0.55</td>
</tr>
<tr>
<td>marking</td>
<td>1026</td>
<td>6</td>
<td>0.58</td>
</tr>
<tr>
<td>respiration</td>
<td>559</td>
<td>3</td>
<td>0.54</td>
</tr>
<tr>
<td>ruin</td>
<td>3566</td>
<td>17</td>
<td>0.48</td>
</tr>
<tr>
<td>transplantation</td>
<td>653</td>
<td>4</td>
<td>0.61</td>
</tr>
<tr>
<td>want</td>
<td>1199</td>
<td>7</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Table 6: Low frequencies with the indef. article

<table>
<thead>
<tr>
<th>noun</th>
<th>total</th>
<th>indefs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>copy</td>
<td>17317</td>
<td>5711</td>
<td>32.98</td>
</tr>
<tr>
<td>decrease</td>
<td>3843</td>
<td>1858</td>
<td>48.35</td>
</tr>
<tr>
<td>respite</td>
<td>1059</td>
<td>374</td>
<td>35.32</td>
</tr>
<tr>
<td>sense</td>
<td>79941</td>
<td>26060</td>
<td>32.6</td>
</tr>
</tbody>
</table>

Table 7: High frequencies with the indef. article

Other eventuality denoting nouns like transplantation or respiration which occur rarely with the indefinite article (Table 6) are often accompanied by further modifiers within the NP, as in the examples below:
a. And many questions whether a machine will ever amount to anything more than a misery-prolonging understudy for a heart transplantation.

b. The organism was thus prepared for flight or fight with a general physiological arousal-exaggerated respiration, dilation of the arteries to the skeletal muscles, increased heart rate and cardiac output, and so forth.

### 3.3. Remarks on the results

In a nutshell, we can state that although the nouns under consideration are lexically classified as being both, count and mass, some preferences in terms of frequencies can be observed. Some nouns occur more often in count than in mass use, which can be observed in the significantly higher number of plural occurrences than singular occurrence. This observation, however, does not yield any further conclusion as to which type or category of nouns behaves like that due to the (almost) equal distribution of certain categories (such as deverbal, deadjectival, zero-derived) in both groups (count and mass). One important factor which manipulates the findings in this corpus study is the degree of lexicalization of certain nouns which have an abstract reading or sense, but the other sense is very dominant and might be perceived as not abstract at all, as e.g. copy#1 or marking#1.

(19) a. copy#1 a reproduction of a written record (e.g. of a legal or school record)

b. marking#1 a distinguishing symbol

As mentioned at the beginning of this section, the presented statistics have to be considered with caution. Corpus evidence can only be indicative, and with this in mind I will reflect on the inferences it draws regarding the count uses I elaborated on in section 3.1. Out of the three types of mass to count transformation in (11), two of them were quite frequent in COCA, i.e. the bounded process (20) and (itemized) placeholders (21).

(20) **BOUNDED PROCESS / EVENT**

a. Many syndicalists saw the strike and the uproar over the trial as vindications of their ideology, and even as models on which to base future actions.

b. The passage on the queen celebrates the ethic of chivalry as a late survival rather than as daily equipment for living in an earlier age.

(21) **(ITEMIZED) PLACE-HOLDERS**

a. Well, with all due respect to Ben Franklin, there are probably three certainties: death, taxes and someone’s out there trying to steal your money.

b. Chloe liked to cook when she had the time, so a decent kitchen was a necessity.

Interestingly, I did not come across examples which I could interpret as instances of certain processes or states, as were some of the count senses described in BECL, such as hope in (13). Speaking of what is being counted when an abstract noun is countable, Grimm (2014) proposes that countable abstract nouns permit anchoring in either participants or events. The event uses in (20) can certainly be interpreted as anchored in events, participant anchoring is also possible, as exemplified in (22).

(22) a. Accepting the law’s validity, however, not only defers and alters Lithuania’s plans for secession but also sharply curtails the hopes for independence of others – Estonians, Latvians, Moldavians and western Ukrainians, all of whom were forcibly
incorporated after the same 1939 pact between Hitler and Stalin.

b. However, small successes reverse a negative spiral into an achievement-success cycle that can turn lives around.

Comparing the outcome of the corpus study with Grimm’s proposed anchoring interpretation yields a verification of such interpretations. However, anchoring in participants and events does not exhaust the possibilities of countable uses of abstract nouns as the examples in (21) show. The reference to certain entities which are true of the predicate under consideration, the respective state or event, is one of the peculiar count uses of abstract nouns, which have not been addressed previously.

4. An analysis of countability distinctions among eventualities

In the following I will reflect on the outcome of both the annotation process as well as the corpus study and give an analysis for a subset of these abstract nouns. I will, however, not be able to account for the whole versatile set of abstract nouns. Instead, I limit the object of study to nouns that fulfil two criteria:

1. MORPHOLOGICAL
   which are depredicated, i.e. derived from verbs, adjectives, other nouns.\footnote{The morphological criterion applies also to nouns in the grey area where it is not entirely clear whether the noun is derived from the verb or the other way round, e.g. license, as well as zero-derived nominals, such as run or jump. Gerunds will be excluded from consideration due to their structural resemblance with verbs.}

2. SEMANTICAL
   which denote an eventuality, in the sense of (Bach, 1986: 62), including dynamic and static states, as well as protracted and momentaneous events among others.

For the purpose of classifying nominals into count or mass, it appears to be useful to take aspectual properties into consideration. In particular, the sole distinction between states and processes on one side and accomplishments and achievements on the other which corresponds to the division of telic and atelic aspect is of relevance for the countability distinctions among these nouns (cf. Verkuyl, 1989). I agree with Krifka (1989) and Hinrichs (1985) (among others) that atelic predicates (processes and states) resemble mass nouns, while telic predicates (accomplishments, achievement) are more like count nouns - an observation which can be witnessed in many examples throughout the empirical study of this paper.

Be that as it may, there are several tendencies which are very stable across eventualities and with regard to these tendencies I wish to establish the following claims:

(23) Generalizations over the count/mass distinction in abstract nouns

1. Telic eventualities are predominantly count. The telicity is either inherent in the lexical meaning of the noun, as e.g. death or birth, or a result of a modification of a process by means of framing it as a terminated event (cf. bounded processes in (11)).

2. Processes are flexible regarding countability. In their core meaning they are unbounded and atelic and as such they are mass nouns, but they regularly shift to telic events which are countable.
3. States are predominantly mass. They are difficult to count and they resist some mass to count coercions. States resemble ordinary concrete mass nouns, as *mud* or *blood*, which are also true of the most minimal parts. Similarly, states go down to the minimal instances of experiencing that state.

A noun that denotes a telic eventuality is thus always count. What is being counted are whole events, transplants or embarrassments, for instance. There is (or can be) a matter of variation of how to count the units, but nevertheless counting is possible because we are dealing with bounded units and we are able to determine the individual events (*a change/an embarrassment/a transplant*), contrary to previous assumptions by Strawson (1959) that eventualities fail to provide a (prima facie) stable and reliable sortal ‘principle for distinguishing and counting individual particulars’, as illustrated by many examples throughout this paper, as for instance in (18) and (20).

Processes are not as stable as telic events, because they vary a lot and it is not particularly clear when a certain process starts and ends. This is visible on the lexical level, as well as in corpus use of such nouns which can appear as count and as mass. It appears naturally possible, however, to count processes. Importantly, although they are atelic activities, once a process occurs in count syntax, it is no longer perceived as atelic. Instead, the count use sets a frame around the process and turns it to a telic event. *Inquiry*, for instance, can be thought of as an atelic process, yet when we put an indefinite article in front of it or pluralize it, we get a count interpretation of an event which consists of the process of inquiry. By this, we limit the process to its temporal boundaries. Consider the self-constructed minimal pairs below which reflect this contrast:

(24) a. There has been **much inquiry** into President Trump’s interactions with Ukraine’s President Zelensky.

   b. There have been **many inquiries** into President Trump’s interactions with Ukraine’s President Zelensky.

Counting processes is just setting boundaries to a certain process and referring to this event which occupies a certain time period. Processes and events are inter-related. Every event consists of a starting point, a process of the action under consideration and a termination point. It follows that every process becomes an event once it terminates, or once the context poses a certain frame, as e.g. through a direct object which is quantized (*drinking a glass of wine vs. drinking wine*). This relation does not have to go in both directions. It is easy to conceptualize a process as a bounded event. The other way round is tricky. It can be achieved with some event nouns. If we think of the event of *drawing a circle* we can conceptualize a process of drawing that circle which took a certain amount of time, but this is certainly not a regular or productive operation which relates to the complexity of events.\(^\text{12}\)

Nouns denoting states present a very stable mass category, as the examples below illustrate. States have (just like ordinary mass nouns, e.g. *blood, water*) a divisive reference.

(25) a. He didn’t have **much faith** that James or Dill would fall for Julianna’s plan,
though lacking a better one, he’d agreed to it.

b. An elderly professor, the attendant was internationally eminent, a sensible man without much need for vanity.

c. I don’t have a lot of certainty about reincarnation, but I have a lot of interest in what lies ahead.

They are true of all the minimal instances. They are difficult to turn to count expressions of the form of a bounded eventuality as is possible with processes.

It appears that what makes such an eventive nominal count or mass is the extent to which the minimal counting units are vague - analogous to what Chierchia (2010) proposes for concrete nouns. What is being counted with events can be determined in a base world, i.e. a telic event. Such an event atom will stay an atom in all further precisifications of the world, i.e. a minimal unit where no proper part is true of that event. Contrary to that are processes. Processes such as run, dance, inquiry and alike have vague minimal parts. Although we can distinguish the presence of a process from its absence, such as when run is true and when not, but within the process run which can last over some time we cannot determine the units of run. It is unclear whether, for instance, the process run starts when the person is holding both legs up, or when the movement of a person reaches a certain speed.

Even if we were able to imagine what counts as one process in that we cut a part of the process run and determine it as the atom in the world w, we will have to face that in another precisification of the world, e.g. w’, a part of that alleged run atom could still count as run. This relation resembles much that of concrete mass nouns. The only option to quantify over such processes is in terms of terminated events. But this yields then a count noun. States on the other hand are different. States, such as faith, love, need are divisive in that they are true of any so minimal parts. We cannot count these states since we cannot determine the minimal units of these states, the minimal atoms of need or love or faith. A part of a state is difficult (if possible at all) to identify because states go down to instances, resembling substances like water or blood.

Since telic events E, processes P and states S denote (some kind of) eventualities, the semantic type of their denotation is event (ν); accordingly their extension has to include events. The difference between P and S one one side and E on the other is the same as between ordinary concrete count nouns and ordinary concrete mass nouns. P(x) and S(x)are mass predicates, contrary to E(x) which is count.

I will make use of Chierchia’s model $M$ which is as a tuple of the form $<U, W, C, \alpha, F>^{13}$ and add a set of events $E$, which stores the extension of event nominals.

(26) \[ E \subseteq U \] is the set of events

Following the previous generalizations concerning telic events, I assume that since they can be individuated and provide a singular/plural alternation, their domain should be in form of a complete, atomic, join semilattice (as assumed in the majority of theories on plurality), which is partially ordered by $\leq$ and closed under a join operation $\cup$, as illustrated in (27).

(27)
The singletons at the bottom present the atomic events, referred to by singular event nominals and the sets above are the sums of these atomic events, which form the extension of plural event nominals.

Let us take some examples for the above categories: *inquiry* for processes (P), *need* for states (S) and *transplant* for events (E). Events have a number alternation; in singular they will denote a set of atomic events, and in plural the sets of sums of atomic events (including the atomic events):

\[
\begin{align*}
\text{denotation of count eventualities (events - E)} &\quad [[\text{transplant}]] = \lambda w. \lambda e. P(w)(e), \text{extn} = \{a, b, c\} \\
\text{denotation of mass eventualities (processes - P and states - S)} &\quad [[\text{inquiry}]] = \lambda w. \lambda e. P(w)(e) \\
&\quad [[\text{need}]] = \lambda w. \lambda e. P(w)(e)
\end{align*}
\]

where \(x\) is of type \(v\)

extn = \{a, b, c, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}

Telic events denote atomic entities - the singletons at the bottom of the lattice. The corresponding plural property will be obtained via the closure operation \(*\) and yields the whole set including sums and atoms: \(*P = \{a, b, c, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\\}. Mass eventualities, on the contrary, do not pluralize since they are sum-closed and by that inherently plural.

However, under certain conditions mass eventualities can shift to a count interpretation. One way of doing so is by switching from an atelic process to a telic process or event. Another way is by referring to what I called (itemized) place-holders in (11). This particular interpretation differs from the previous in that it no longer refers to the event, but rather to a thematic role of that event, most probably (but not exclusively) the *theme*.

The shift from atelic processes to telic events can be accomplished by the common procedure of packaging. I will adopt here Chierchia’s partition operator \(\sqcap_{14}\) which derives countable units.
or packages of the process. Applying $\sqcap$ to a mass eventuality will yield an atomic property which satisfies the requirement of relative atomicity:

\[(30) \quad AT(\sqcap(P)) = \sqcap(P)\]

If $x$ is a member of a partition of $P$, no proper part of $x$ is (relative atomicity)

### 4.1. Reference to thematic roles

During the lexical annotations process I identified a count use of eventualities which has been confirmed by the corpus study, i.e. that countable eventive nouns (can) refer to entities which have the property denoted by the predicate, or which describe the result of the event, as illustrated in (16) and (14). I called such occurrences \textit{(itemized) place-holders}. It appears that this interpretation can be understood as referring to an argument of the event, e.g. the theme or patient. I therefore argue that event denoting nominals can also refer to the thematic roles, most probably (but not exclusively) the \textit{theme}. This specific interpretation of derived nominals includes also cases which Grimshaw (1990) and Alexiadou et al. (2010) call \textit{result nominals}, or Melloni (2007) \textit{referential nouns}. Result nominals, too, refer to the result of the event which can be understood as the thematic role of the event. The denotation of such a nominal differs from the one in (28) in that it refers to the theme of the event, as illustrated in (31).

\[(31) \quad \lambda w. \lambda x \lambda e. P(w)(e) \land TH(w)(e, x) \]

where \(TH(w)(e, x) = x\) is the theme of $e$ in $w$

Importantly, (31) is not the lexical entry of the eventive noun. I believe that the lexical entries for eventive nominals are uniform throughout the different interpretation as proposed in (28), but the reference to a thematic role has to be adjoined at a higher position of a functional projection. A detailed elaboration of the architecture of (31) can be found in Husić (2020).

### 5. Summary and Discussion

This paper has tried to bring us a bit closer in solving the puzzle of countability distinctions in abstract nouns. By an empirical study of a set of abstract nouns, I was able to determine generalizations that relate to a subset of abstract nouns - eventuality denoting nominals. In a nutshell: the aspectual properties of the events denoted by these nominals seem to be responsible for the countability assignment. Telic eventualities are always countable, while atelic eventualities, such as processes or states are predominantly mass. However, processes are related to events in that they can turn to telic predicates by compositional means which then yields a count noun. This state of affairs confirms previous observations which relate telicity to countness.

With regard to eventualities, I argued that such nouns can also refer to thematic roles of the underlying event. The more common description of similar cases in linguistic literature is \textit{Result Nominals} (Grimshaw, 1990; Alexiadou et al., 2010) which is a more restricted interpretation than the reference to thematic roles. What I call \textit{reference to thematic roles} applies also to states which do not have a result per se, as for instance \textit{certainty} and \textit{necessity} in (21). The idea of referring to a thematic role of the event by the event nominal itself sheds new light on the event semantics in the nominal domain.

I argued in favor of a vagueness based approach to the countability of nouns which offers a
possibility to conceptualize the differences in count and mass eventualities. It remains to be tested whether such an approach can also account for the countability distinction among other non-eventive abstract nouns, such as measure and time terms.

References


Rhetorical imperatives: expressing anti-preferences
Shun IHARA — JSPS/Ritsumeikan University
Mana ASANO — Osaka University

Abstract. Almost all studies of rhetorical speech acts have exclusively focused on questions so far (Caponigro & Sprouse 2007, Biezma & Rawlins 2017, among others). This paper provides a detailed investigation of what we call Rhetorical Imperatives (RhIs). The hallmark of RhIs is that despite their imperative form without any negation, the speaker does not demand an action but rather conveys a flavor of a prohibition. In this paper, we propose that RhIs are imperatives that signal that content of a clause is already common-grounded in parallel to rhetorical questions, and that the speaker of a RhI has an anti-preference for the uttered content over alternatives.

Keywords: rhetorical imperatives, speech acts, modality, dynamic semantics, Japanese.

1. Introduction

Although the meaning of ‘rhetorical’ has attracted attention in many fields of linguistics, almost all studies of rhetorical speech acts have exclusively focused on questions so far (e.g., Sadock, 1971; Han, 2002; Caponigro & Sprouse, 2007; Biezma & Rawlins, 2017; among others). This paper investigates what we call Rhetorical Imperatives (RhIs) in Japanese, providing a unified account of rhetorical and non-rhetorical speech acts. In line with Asano & Ihara (2019), we informally define RhIs as “utterances which have an imperative form but convey some anti-imperative properties (which will be presented in the next section).” The most striking property of RhIs is that despite their imperative form without any negation, the speaker does not demand action but rather conveys a flavor of ‘prohibition’ or ‘complaint.’ Consider the following examples:

(1) (The addressee has just told a lie to the speaker)
   Uso tsuk-e!
   lie  tell-IMP
   ‘[lit.] Tell me a lie!’
   ⇾ ‘You shouldn’t have told me such a lie!’ (not performative)
   ↖ ‘You should tell me a lie!’ (performative)

(2) A: I’m in love with my bed, but my alarm clock won’t let us be together.
   B: Hozak-e.
   say.stupid.thing-IMP now  busy-NMLZ-COP DP
   ‘[lit.] Say a stupid thing. (I’m busy, you know.)’
   ⇾ ‘You shouldn’t have said such a stupid thing.’ (not performative)
   ↖ ‘You should say a stupid thing.’ (performative)

In (1), although the literal meaning does not differ from ordinal imperatives, the actual interpretation of (1) contains a negative meaning and no performativity is observed; intuitively

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speaking, the speaker in (1) rather complains that the addressee told a lie, or prohibits the addressee from telling a lie. Similarly, (2) does not exhibit performative interpretation but instead it describes that the speaker complains about the addressee’s stupid utterance and that (s)he does not want to hear it anymore. Given this property, the questions arise as to how the negative and non-performative meaning of RHIs is generated, and why Japanese imperatives allow this sort of rhetorical interpretation. Regarding these two questions, this paper proposes that RHIs are imperatives that signal the following two pieces of content: (i) a propositional content is already common-grounded (in parallel to rhetorical questions), and; (ii) the speaker has (what we call) an anti-preference.

The organization of this paper is as follows. Section 2 observes three hallmarks of RHIs, anti-preferability, anti-future-orientativity, and anti-directivity. Based on the observations in Section 2, Section 3 introduces the framework we use for the analysis of RHIs, which is known as the Table model (Farkas & Bruce 2010, Malamud & Stepheson 2015, Farkas & Roelofsen 2017), and then provides an assumption and a sub-proposal on the discourse semantics and pragmatics of imperatives in Japanese. Section 4 provides our proposal on RHIs, and illustrates how the rhetorical effects of RHIs are derived. Section 5 concludes this paper.

2. The hallmarks of rhetorical imperatives

As indicated in the introduction, RHIs exhibit the properties which are not obtained in ordinary imperatives (OIs). This section observes the three idiosyncratic properties of RHIs, anti-preferability, anti-future-orientativity, and anti-directivity, by making comparisons with OIs.

2.1. Anti-preferability

In the case of OIs, the speaker utters IMP(ϕ) to show his or her preference for ϕ over ¬ϕ (Kaufmann, 2012; Condoravdi & Lauer, 2012), while this property is absent in RHIs. The relevant examples are as follows:

(3) a. Hayaku ne-ro! Ore-wa ne-te { hoshii / #hoshiku-nai } 
   quickly go.to-bed-IMP I-TOP go.to.bed-GER { want / #want-NEG } 
   n-da yo. NMLZ-COP SFP
   ‘Go to bed quickly! I { want / #don’t want } you to go to bed.’

   b. Uso tsuk-e! Ore-wa uso-o tsui-te { #hoshii / hoshiku-nai } n-da yo. 
      lie tell-IMP I-TOP lie-ACC tell-GER { #want / want-NEG } NMLZ-COP SFP
      ‘You shouldn’t have told me such a lie! I { #want / don’t want } you to tell the lie.’

Imperatives in (3a) and (3b) are an OI and a RH, respectively. In the subsequent utterances of both imperatives, hoshii ‘want’ describes the speaker’s preference for the prejacent ϕ, while the negated version hoshiku-nai ‘do not want’ conveys the opposite attitude. The same ϕ is embedded under the imperatives and the subsequent utterances in (3a) and (3b). In (3a), the subsequent utterance with hoshii is felicitous while the one with hoshiku-nai is infelicitous. Thus, the example (3a) indicates that the imperative describes the speaker’s preference for ϕ. When it comes to RHIs, they show the opposite pattern to (3a) with respect to subsequent utterances. For instance, in (3b), the sentence can precede the utterance with hoshiku-nai, while
the subsequent utterance with hoshii is degraded. The contrast indicates that, unlike OIs, RIs show a preference for \( \neg \varphi \), rather than for \( \varphi \) (Asano & Ihara 2019). We refer to this property of RIs ‘anti-preferability.’

2.2. Anti-future-orientativity

RIs are also different from OIs with respect to the time an event described by an imperative occurs. In the case of OIs, the speaker presupposes that an event of an imperative must occur in the future time (Kaufmann 2012). On the other hand, RIs require that an event of an imperative have occurred before RIs are uttered. This contrast is observed between an OI (4a) and a RIs in (4b).

(4) a. Hayaku ne-ro! #Nande ne-ta no?
   quickly go.to.bed-IMP why go.to.bed-PAST Q
   ‘Go to bed quickly! #Why have you gone to bed?’

b. Uso tsuk-e! Nande sonna uso-o tsui-ta no?
   lie tell-IMP why such lie-ACC tell-PAST Q
   ‘You shouldn’t have told me such a lie! Why have you told me such a lie?’

In (4a), the subsequent utterance describes that an event of the imperative has already occurred. Since this utterance is infelicitous, (4a) suggests that OIs are future-oriented. Unlike (4a), this subsequent utterance is felicitous in (4b). From the data above, we can see that the Ri refers to an event which has already occurred in the past, which suggests that RIs are ‘anti-future-oriented.’

The anti-future-orientativity of RIs is also evident from the following examples. RIs can never be interpreted as rhetorical utterances when they are uttered in out-of-the-blue contexts (i.e. contexts where imperative contents are possible to be fulfilled in the future). Consider the following example:

(5) (The speaker suddenly calls to the addressee from behind and says)
   Uso tsuk-e!
   lie tell-IMP
   \( \sim \) Tell me a lie! (directive)
   \( \not\sim \) You shouldn’t have told me such a lie! (rhetorical)

Given the context above, the rhetorical interpretation is rejected and only the ordinary (i.e. directive) interpretation is allowed in (5). Here, the interpretation as an OI is assumed to be attributed to the out-of-the-blue context, where the event of the imperative has not been occurred yet. This example indicates that RIs require the violation of the future-orientativity of imperatives.

2.3. Anti-directivity

The last striking property of RIs is that the discourse effect of uttering an imperative with a rhetorical reading is akin to that of an assertion rather than that of a directive. We can see this by observing the response patterns and their effects: observe the following contrast between an assertion and an OI.
The utterance of A in (6) is an assertion, while the one of A in (7) is an OI. We can see a clear contrast between them with respect to their response patterns. Following Farkas & Bruce (2010) who classify utterances of responses like right, yup, etc. as examples of assertion confirmation and no way, definitely not, etc. as examples of assertion denial, we regard sono toori (desu) ‘that’s right.’ in (6B) and (7B) as an assertion confirmation, while iya, tigau ‘no, you’re wrong.’ in (6B′) and (7B′) as an assertion denial. Since they can be used to confirm or deny assertions, they are felicitous as the responses to A’s assertion in (6), but are infelicitous as the responses to A’s directive (7). In contrast, the (in)felicity of ryookai ‘I accept it’ and kotowa-ru observed in (6) and (7) indicates that these two utterances can only be uttered as responses to directives but not as ones to assertions. Based on the observation in (6) and (7), we introduce ryookai ‘I accept it’ in (6B) and (7B) and kotowa-ru in (6B′) and (7B′) as a directive acceptance and a directive denial, respectively. Given these response patterns, let us move on to the observation of RhIs:

As shown above, the response pattern in (8) is parallel to that of the assertion in (6) rather than the OI in (7); while the RhI can be responded by the assertion confirmation sono toori-desu and the assertion denial tigaimasu, the acceptance ryookai and the denial kotowa-ru are judged to be infelicitous. The current observation indicates that RhIs lack directivity (in the sense that...
their discourse effects do not contribute to directive force); despite their imperative form, they encode what we call the “anti-directive” property.

The unembeddability of rhts in directive predicates provides further evidence for the anti-directivity of rhts. Consider the following example:

(9) Directive-taking predicate ‘order’:
Ayaka-ga Hanako-ni [σ uso tsuk-e ] to meireishi-ta.
Ayaka-GEN Hanako-to lie tell-IMP C order-PAST
‘Ayaka ordered Hanako S.’
∼ S: Tell a lie! (directive)
≠ S: You shouldn’t have told me such a lie! (rhetorical)

(10) Assertion-taking predicate ‘decide’:
Kono joohoo-ni-wa [σ uso tsuk-e ] to kimetsukeru koe-ga
this information-to-TOP lie tell-IMP C decide comment-GEN
sattooshi-ta yooda.
rush-PAST seem
‘The news apparently prompted a flood of people to conclude S.’
≠ S: Tell a lie! (directive)
∼ S: You shouldn’t have told me such a lie! (rhetorical)

In (9), the verb meireisu ‘order’ is a directive predicate while kimetsukeru ‘decide’ in (10) is an assertive predicate. As shown in the examples, the rhetorical interpretation (= ‘you shouldn’t have told me such a lie!’) is possible only in (10), which suggests that rhts cannot be embedded or quoted under directive predicates. This contrast lends support to the view that rhts lack the directivity, in contrast to ots.

3. Ingredients: the dynamic model of discourse

This section briefly gives background on the framework of our analysis, and then extends the model to Japanese ordinary imperatives.

3.1. The Table model for imperatives

We make use of the formal discourse model called the Table model developed by Farkas & Bruce (2010), which is in effect an elaboration of Stalnaker (1978). In the Table model, assertions are not considered as contributing direct updates of the Common Ground (CG), but are analyzed as contributing proposals to update this set, in which the speaker takes on a public discourse commitment and projects the future CG. Since not all of the discourse components of this model are useful for our purpose, we just introduce relevant components:

(11) Basic components of the Table model (Farkas & Bruce 2010):
    a. COMMON GROUND (CG):
The set of all propositions that all discourse participants are committed to.
    b. DISCOURSE COMMITMENTS (DC):
   For all discourse participants $a$, there is a set $DC_a$ of propositions that $a$ has committed to.
c. **The Table** ($T$):
   A stack of **Issues** (sets of propositions), the uppermost element of which ($max(T)$) is currently at issue.

d. **The Projected Set** ($PS$):
The set of all CGs that could result by adding an element of $max(T)$ to the current CG (intuitively the future CG).

These components allow us to define the discourse context $K$ as follows:

(12) A discourse context $K^n = \langle A^n, DC^n, T^n, CG^n, PS^n \rangle$, where:
   a. $A^n$ is a set of individuals $a$;
   b. $DC^n$ is a set of sets of discourse commitments $DC^n_a$, one for each $a \in A^n$;
   c. $T^n$ is a table;
   d. $CG^n$ and $PS^n$ are a Common Ground and a Projected Set such that $PS^n = \{CG^n + p : p \in max(T)\}$.

Formally, an assertion of a sentence denoting a proposition $\phi$, $\text{ASSERT}(\phi)$, is a function from contexts ($K$) to contexts ($K'$) of the following form:

(13) $\left[\text{\textsc{assert}}\right] = \lambda \phi \langle \sigma, \lambda K_k \rangle K' \begin{bmatrix} DC_{sp} = DC^K_{sp} + \phi \\ T = T^K + \{\phi\} \\ PS = \{CG^K + \phi\} \\ K' = K \text{ in all other respects} \end{bmatrix}$

a. $DC_{sp} = DC^K_{sp} + \phi$
   (i.e.: Adds $\phi$ to the speaker’s $DC$ in $K$.)

b. $T = T^K + \{\phi\}$
   (i.e.: Adds $\phi$ to $T$ in $K$.)

c. $PS = \{CG^K + \phi\}$
   (i.e.: The result of the utterance is $CG$ that contains $\phi$.)

d. In all other respects, $K' = K$.  
   (cf. Farkas & Bruce 2010:(9))

More intuitively, an assertion returns a context such that: (a) the speaker makes discourse commitment to $\phi$, (b) the current issue/topic of the discourse is $\phi$, and (c) the speaker expects that the addressee will also be committed to $\phi$.

Crucially, in Farkas & Bruce, all components of the Table model are modally unified: they are to be interpreted epistemically or doxastically. That is, the speaker’s discourse commitments are propositions that they are presenting themselves as though they believe: the propositions in the Table are those propositions currently under consideration as potential mutual epistemic/doxastic commitments, and the projected set represents what it would look like if those potential mutual doxastic commitments were made.

Before moving on to show how imperatives are analyzed in the Table model, following Rudin (2018), we further assume the extended version of the model. Rudin proposes a programmatic extension of the Table model that bifurcates it into doxastic (or epistemic) and teleological (or deontic) halves, identical to each other except in terms of the modal interpretation of their components. The doxastic half of the model is identical to the standard model introduced above; an assertion puts a proposition into the doxastic discourse commitment of the speaker. Imperatives, on the other hand, do exactly the same thing that standard assertions do, except that they...
interact with the teleological half of the Table model, the *teleological discourse commitment*, not the doxastic half. Following Condoravdi & Lauer (2012), Rudin assumes that the modality relevant to the teleological commitment is effective preferences. The core idea of the effective preference is that, intuitively, imperatives encode the speaker’s preference which is ordered with respect to other preferences.²

(14) Discourse commitments (bifurcated version):
   a. For all discourse participants \( a \in A \),
      \( DC_a = \langle DC_{dox,a}, DC_{tel,a} \rangle \), where:
   b. \( DC_{dox,a} \) (doxastic discourse commitment) is a set of propositions that \( a \) is publicly committed to acting as though she believes;
   c. \( DC_{tel,a} \) (teleological discourse commitment) is a set of propositions that \( a \) is publicly committed to acting as though she has an effective preference for.

(Rudin 2018:(33))

By stating the condition in (15), Rudin ensures that teleological discourse commitments are required to be both consistent and realistic.

(15) Realism condition on \( DC_{tel,a} \):
   For any agent \( a \), \[ \forall p : p \in DC_{tel,a} \cap \bigcap DC_{dox,a} \neq \emptyset. \]
   (ibid.: (34))

The common ground, the table, and the projected set can be bifurcated in the same way as the discourse commitment: the teleological common ground \( CG_{tel} \) is the set of all propositions that all interlocutors are publicly committed to having an effective preference for, the teleological Table \( T_{tel} \) hosts content under consideration for incorporation into \( CG_{tel} \), and the teleological projected set \( PS_{tel} \) contains a set of possible future \( CG_{tel} \), one incorporating each element of the \( \max(T_{tel}) \).

(16) Common ground (bifurcated version):
   \[ CG = \langle CG_{dox}, CG_{tel} \rangle, \]
   where:
   a. \( CG_{dox} = \{ p : \forall a, p \in DC_{dox,a} \} \)
   b. \( CG_{tel} = \{ p : \forall a, p \in DC_{tel,a} \} \)

(17) The Table (bifurcated version):
   \[ T = \langle T_{dox}, T_{tel} \rangle, \]
   where:
   a. the maximal element of \( T_{dox}, \max(T_{dox}) \), represents the propositions that are currently candidates for becoming members of \( CG_{dox} \);
   b. the maximal element of \( T_{tel}, \max(T_{tel}) \), represents the propositions that are currently candidates for becoming members of \( CG_{tel} \).

(18) The projected set (bifurcated version):
   \[ PS = \langle PS_{dox}, PS_{tel} \rangle, \]
   where:
   a. \( PS_{dox} = \{ CG_{dox} + p : p \in \max(T_{dox}) \} \)

²Formally, the effective preference structure is defined in (i).

(i) **Preference Structure** (Condoravdi & Lauer 2012: 45):
   A preference structure relative to an information state \( W \) is a pair \( \langle P, \leq \rangle \) where \( P \subseteq \wp(W) \) and \( \leq \) is a partial order on \( P \).

An alternative implementation might be possible in which the relevant modality is priority modality (Portner 2007).
b. $PS_{tel} = \{CG_{tel} + p : p \in \max(T_{tel})\}$

3.2. Imperatives in Japanese are alternative imperatives

Given the settings in the last section, let us now derive the interpretation of ordinary imperatives. Since we are assuming that imperatives are associated with an effective preference structure, they are interpreted as the speaker’s preferential attitudes as below.

(19) $[[\text{Go to bed!}]]^w$
    $\approx [[\text{I want you to go to bed at } w]]$

Departing from the standard view of imperatives that they denote a single proposition (or property), we argue that an imperative sentence-radical (or an imperative morphology) in Japanese takes a non-singleton set of alternatives, basically a set containing a proposition and its negation, $!\varphi = \{\varphi, \neg \varphi\}$. We suggest that the ability of having both the ordinary reading and the rhetorical reading is the result of an exhaustification of possibilities of updating commitments.3

Just like alternative questions in English are disjunctive questions with a final falling contour (Biezma & Rawlins 2015), imperatives in Japanese are semantically alternative imperatives, and their entire discourse effects are determined by contexts or some linguistic elements (e.g. sentence-final contours or particles). Let us illustrate how ordinary (strong) readings are derived. Assuming imperatives encode the left-peripheral IMP operator, an imperative contributes to update the context in the same way as an assertion, only with respect to the teleological half of the context. In the ordinary reading, Japanese imperatives result in the following update.

(20) $[[\text{IMP}]]=\lambda ! \varphi_{(st,t)}, \lambda K^t$
    \[
    \begin{align*}
    & (i) DC_{tel,sp} = DC^K_{tel,sp} + \{\varphi, \neg \varphi\} \\
    & (ii) T_{tel} = T^K_{tel} + !\varphi \\
    & (iii) PS = \{CG^K_{tel} + \varphi, \notin CG^K_{tel} + \varphi\} \\
    & (iv) K' = K \text{ in all other respects}
    \end{align*}
    \]

In (20), an imperative conveys that: (i) the speaker has a preference for $\varphi$ (by putting $\varphi$ to $DC_{tel,sp}$), (ii) whether $\varphi$ or not is currently at issue (by putting $!\varphi = \{\varphi, \neg \varphi\}$ to $T_{tel}$), and (iii) the result of the utterance is that both the speaker and the addressee have a preference for $\varphi$ (by putting $CG^K_{tel} + \varphi$ to $PS$). The question here is how the exhaustifications in (i) and (iii) of (20) are derived. To implement this update, we would like to make some Gricean assumptions about the application of the maxim of QUALITY (Grice 1975) as they apply to making teleological commitments and projections in (21) and (22), both of which are proposed by Rudin:

(21) QUALITY-commitment:
    a. Do not add a proposition to $DC_{tel}$ if it is incompatible with the maximal elements of your effective preference structure.
    b. Do not add a proposition to $DC_{tel}$ if it is not a maximal element of your private effective preference structure. (Rudin 2018: (46))

(22) QUALITY-project:

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3Note that the idea here is inspired by Oikonomou’s (2016) proposal that the strong reading of imperatives is due to an implicature conveyed by an exhaustification of certain focus alternatives that contain an uttered content and its negation, although the way of deriving the effects is different from her account.
a. Do not add a hypothetical Common Ground \((CG_{tel} + p)\) to the projected set \((PS)\) if an interlocutor makes a public commitment that is incompatible with that Common Ground. (i.e.: Don’t project \(CG_{tel} + p\) if there is an interlocutor \(i\) such that \(\bigcap DC_{tel,i} \cap p = \emptyset\).)

b. Do not add a hypothetical Common Ground to the projected set if you have reason to believe there is an interlocutor whose private effective preferences are incompatible with that Common Ground. (i.e.: Don’t project \(CG_{tel} + p\) if you have reason to believe there is an interlocutor whose private effective preferences entail \(\neg p\).) (ibid.: (48))

In short, it is not cooperative to make a teleological commitment that you do not want to do, or to project a \(CG\) that you have reason to believe could not actually come about. Given the maxim above, whether \(\varphi\) or \(\neg \varphi\) goes to \(DC_{tel}\) depends on the exhausification by the speaker’s effective preference. In (20), an imperative clause has \(!\varphi = \{\varphi, \neg \varphi\}\), and attempts to put \(!\varphi\) on the speaker’s \(DC_{tel}\) (just like an assertion does on \(DC_{dox}\)), but there is a ban on updating \(DC_{tel}\)—the maxim of QUALITY commitment. Since in ordinary imperatives, only the highlighted proposition \(\varphi\) is the maximal element of the speaker’s effective preference, \(\neg \varphi\) in \(!\varphi\), which is incompatible with \(\varphi\), cannot be added to \(DC_{tel}\). This exhausts the space of the updating, thus deriving \(!\varphi = \{\varphi\}\). The update here automatically determines whether \(CG_{tel} + \varphi\) or \(CG_{tel} + \neg \varphi\) is projected; an imperative clause attempts to project both \(CG_{tel} + \varphi\) and \(CG_{tel} + \neg \varphi\), \(PS = \{CG_{tel} + \varphi, CG_{tel} + \neg \varphi\}\), but by the maxim of QUALITY project, \(CG_{tel} + \neg \varphi\), which is incompatible with the speaker’s current commitment \(DC_{tel} + \varphi\), cannot be added to \(PS\), which leads to an updated \(PS = \{CG_{tel} + \varphi\}\).

The proposal here applies to the case of rising imperatives. Rudin (2018) argues that imperatives with rising intonations (the L*H-H% tune, ‘⇑’) are conventionally weak, lacking speaker commitment, and thereby sound much more tentative/suggesting than ordinary falling imperatives. Although Japanese imperatives accompanied by the L*H-H% tune have not been observed in prior literature, we find they also have almost the same effect as observed in imperatives in English.

(23)  

\begin{align*}
\text{(a)} \quad & \text{Hayaku ryuugaku shi-ro (yo)! (#Shite-hoshiku-nai kedo.)} \\
& \text{quickly study.abroad do-IMP PRT do-want.to-NEG but} \\
& \text{‘Study abroad as soon as possible! (#But I don’t want you to.)’} \\
\text{(b)} \quad & \text{Hayaku ryuugaku shi-ro (yo) ?} \text{? (Shite-hoshiku-nai kedo.)} \\
& \text{quickly study.abroad do-IMP PRT do-want.to-NEG but} \\
& \text{‘You’d better to study abroad as soon as possible!! (But I don’t want you to.)’}
\end{align*}

Intuitively, in (23a), the speaker seems to be instructing the addressee to study abroad, whereas the speaker in (23b) is only giving advice. Following Truckenbrodt (2006) and Rudin (2018), the L*H-H% tune (monotonically rising intonation) applies to a function from contexts to contexts and overrides speaker commitment, as defined in (24):

(24)  

\[
\text{Let } C \text{ be an abbreviation for type } \langle ek, k \rangle \text{ (a function from contexts to contexts),}
\]

\[
\left[ [L^{*H-H\%}] \right] = \lambda C, \lambda K_k. \left[ K^r \mid DC_{sp} = DC^K_{sp} \right]
\]

\[
K' = C(K) \text{ in all other respects.}
\]

The effect of rising imperatives in Japanese seems to be very close to the one observed in conditional imperatives. See Condoravdi & Lauer (2017) for extensive discussion.
However, (24) still fails to capture our intuition about rising imperatives in Japanese. That is, in rising imperatives, there is a nuance that they tell the addressee that the way to achieve the goal is to perform the action, while simultaneously asserting that the speaker does not want the addressee to do so. The compositional effect of (20) and (24) is insufficient to capture this, since it lacks the nuance of ‘how-to’; it just conveys that the speaker raises an issue containing the proposition of the imperative sentence radical \{φ, ¬φ\} without any commitments (i.e. that the speaker is indifferent whether φ or ¬φ).

Our (somewhat tentative) suggestion is to introduce the conventional effect of rising intonation, following Farkas & Roelofsen (2017). They propose that both rising declaratives and tag interrogatives signal that the speaker has access to some evidence for the highlighted (i.e. uttered) alternative, and specify this effect as the special discourse effect. Although we will not discuss intonational effects of speech acts in details for the aim of this work, we suggest that their proposal is also applicable to rising imperatives in Japanese. The idea here is that while content counted as evidence in declaratives or interrogatives is evidence for asserting or questioning so, content in imperatives is ground or a reason for advising or endorsing so. For example in (23b), the speaker is not teleologically committed to φ, but (s)he at least has some good ground or reasons for the addressee’s performing φ, e.g. you can find new interests when you study abroad, studying abroad grants you the opportunity to study a foreign language, you will have the chance to see a side of your major, etc. A complete work for the formalization is left for our future task, but we believe that this line of analysis captures our intuition about rising imperatives in Japanese.

4. Back to rhetorical imperatives

4.1. Deriving rhetorical interpretations

This section attempts to derive the discourse effect of RhIs. The core idea of our proposal is that RhIs are imperatives that signal that content of a clause is already common-grounded in parallel to rhetorical questions, and that the speaker has an anti-preference for the uttered content over alternatives. These constraints exhaust the possibilities of the update, thus lead to a limited (i.e. rhetorical) interpretation.

Our first proposal highlights the status of the common-ground associated with a given utterance. As represented in (25), we suggest that RhIs are imperatives whose contents are known to both the speaker and the addressee; in other words, imperatives in which the content of the request is part of the common-ground.

\[
\text{Presupposition of IMP}_{RHET}(\varphi) \text{ in } K: \\
\varphi_{wd'} \in CG^K_{dox}, \text{ where } t' \prec t_K. \\
(t_K \text{ is an utterance time in } K, \text{ cf. Kaufmann 2012})
\]

Crucially, a proposition φ of IMP_{RHET}(φ) must refer to a particular past time event frame t' \prec t_K; intuitively speaking, the speaker thinks that (s)he wants the addressee to φ in the past. As we will argue in detail in the next section, this is why RhIs are interpreted like a past deontic modalized sentence should.have(p).

In this way, we can analyze the relationship between ordinary imperatives and RhIs in a way...
parallel to how we think about the relationship between ordinary questions and rhetorical questions; rhetorical questions are questions whose ‘answers’ are common-grounded (cf. Caponi-igro & Sprouse 2007), while Rhts are imperatives whose ‘desirable contents’ are common-grounded. That is, rhetorical interpretations of speech acts are triggered by the common-ground in general.

The sufficient condition of Rhts is not just the CG constraint. We moreover suggest to focus on the notion of what we call the anti-preference; as observed in section 2.1, since the speaker of a Rhi ‘IMP[RHET(ψ)]’ has an effective preference for ψ over ¬ψ, this ¬ψ, rather than ψ, is the content that should be added to the teleological discourse commitment. This discourse move of Rhts is formalized in (26):

\[
\text{Anti-preference effect of IMP[RHET(ψ)] in } K: \quad DC^K_{\text{tel},sp} = DC^K_{\text{tel},sp} + ψ \\
\text{(i.e.: Update } K \text{ by adding } ¬ψ \text{ to the speaker’s } DC_{\text{tel}} \text{ in } K.)
\]

Given these settings, let us propose the discourse move of Rhts in (27):

\[
\text{[[IMP[RHET]]] } = \lambda !φ_{w,t'} . λ K'. \begin{cases} 
(i) \quad φ_{w,t'-tk} ∈ CG^K_{\text{dox}} \\
(ii) \quad DC_{\text{tel},sp} = DC^K_{\text{tel},sp} + \{ φ_{w,t'} , ¬φ_{w,t'} \} \\
(iii) \quad T_{\text{tel}} = T^K_{\text{tel}} + \{ φ_{w,t'} , ¬φ_{w,t'} \} \\
(iv) \quad PS = \left\{ CG^K_{\text{tel}} + φ_{w,t'} , CG^K_{\text{tel}} + ¬φ_{w,t'} \right\} \\
(v) \quad K' = K \text{ in all other respects}
\end{cases}
\]

Intuitively, (27) conveys that: (i) the content of ψ is already common-grounded (by (25)), (ii) the speaker has an anti-preference for ψ, (iii) ¬ψ is currently at issue at the same time, and (iv) the projected common-ground only contains ¬ψ. The exhaustifications in (ii) and (iv) happen in almost the same way as OIs; in (ii) given the maxim of (21), whether ψ or ¬ψ goes to DC_{t} depends on the speaker’s effective preference. Unlike OIs, since ¬ψ rather than ψ is the maximal element of the speaker’s effective preference in Rhts, ψ, which is incompatible with ¬ψ, cannot be added to DC_{t}. This automatically exhaustifies the space of updating PS in (iv). Although both CG_{t} + ψ and CG_{t} + ¬ψ are originally the possible future CGs, by the maxim in (22), CG_{t} + ψ, which is not compatible with DC_{t} + ¬ψ, cannot be added.

What we should consider now is the update in (iii): how are the contents added to the Table exhausted, unlike the case of OIs? We argue that this is due to the presupposition of Rhts: in (iii), an imperative clause attempts to put !ψ on T. At the same time, it is presupposed that φ_{w,t'} is doxastically common-grounded, φ_{w,t'} ∈ CG^K_{\text{dox}} (= (i)): this φ_{w,t'} ∈ CG^K_{\text{dox}} exhaustifies the space of possibilities of updating, hence !ψ = {¬φ_{w,t'}}. This is motivated by a general fact that deontic modalized sentences conveying counterfactuality cannot update a context with their prejacent in contexts where the prejacent are doxastically common-grounded (cf. Diversity Condition, Condoravdi 2002). In other words, a proposition ψ of a deontic modalized sentence DEON(ψ) cannot be a possibility of an update (i.e. content added to T) if ψ is known by the discourse agents. Consider (28), a case where the fact ‘the addressee returned the book’ is common-grounded doxastically.

\[
\text{According to the library regulations, the addressee returned the book yesterday.}
\]

\text{See Thomas (2014) for Diversity Condition in deontic modals.}
a. #You should have returned the book yesterday.
b. You shouldn’t have returned the book yesterday.

It seems that we could generalize this as follows: a counterfactual utterance $CF(\varphi)$ cannot update a context $K$ with $\varphi$ if $K$ entails $\varphi \in CG_{dax}$. Rhts also trigger a counterfactuality (cf. (4a)), however, they are not infelicitous in such contexts, because an imperative clause has multiple possibilities $\{\varphi_{w,t'}, \neg \varphi_{w,t'}\}$. Thanks to this multiplicity, the non-common-grounded one ($\neg \varphi_{w,t'}$ in Rhts) can stay alive, even when the common-grounded one is exhaustified, $\{\varphi_{w,t'}, \neg \varphi_{w,t'}\}$.

Why is the entire effect of Rhts interpreted like the one of assertions, though? How can we derive the anti-directivity of Rhts observed in section 2.3? We claim that this is because an issue raised by Rhts refers to a particular past time event frame $t' \prec t_K$. Following Kaufmann (2012), we make the assumption that directive speech acts require the temporal condition ‘that an event of an imperative is satisfied at or following utterance time’ to be satisfied. Since Rhts always violate this condition (cf. section 2.2), they are no longer interpreted as directives, but end up being assertions that lack a directive performativity. We can therefore hypothesize that if an imperative clause aceptably denotes a proposition that refers to a past event, the clause is interpreted as an assertion rather than a directive (cf. Ninan 2008, Thomas 2014). An independent motivation for this line of analysis is that Japanese imperatives can include past events in the domain of evaluation.\(^6\) See (29) for the relevant example. It is worth noting that in (29), the imperative is not classified to Rhts, since it does not exhibit any anti-preference.

\[(29)\] (One morning, after the children went to school, the mother came to the dining table and found that the children’s breakfast was left uneaten. The mother sighs and says)

Zenbu tabe-ro yo!
‘[lit.] Eat everything!’
\(~\) They should’ve eaten everything! (not performative)

In (29), the interpretation of the sentence is restricted to the non-performative (assertive) reading despite its imperative form. As expected, the natural answer to (29) must be either “Right” or “No, you’re wrong,” rather than “I accept your order” or “No, I refuse your order,” cf. (6).

The current discussion of past imperatives indicates that our hypothesis that imperatives in Japanese are assertive if they include past events in their domain of evaluation is correct, and further provides us an account for the fact that Rhts are always assertive; the anti-directive property of Rhts is derived by their lack of future-orientativity.

4.2. Motivations for the disjunctive view

Before concluding this section, let us consider further motivations to adopt the idea that imperatives in Japanese are non-singleton set of alternatives. First, let us examine what would have been expected of Rhts if we had not adopted this line of approach. For instance, if we assume, following the traditional and standard view, that they have a single proposition (or property),

\(^6\) Note that in Japanese, an imperative morphology (i.e. -e/ro) does not itself entail the directive performativity; rather, it only encodes modal meaning, and the directivity is independently conveyed by the directive presupposition (or implicature) operator (Ihara 2020).
RhIs would be analyzed as (30), maintaining the maxims and the presupposition of RhIs:

\[
[\text{IMP}_{\text{Rhet}}] = \lambda \varphi_{w,t'} \lambda K. \begin{bmatrix}
\text{(i) } \varphi_{w,t'-t_K} \in CG_{dox}^K \\
\text{(ii) } DC_{tel,sp} = DC^K_{tel,sp} + \{ \varphi_{w,t'} \} \\
\text{(iii) } T_{tel} = T^K_{tel} + \{ \varphi_{w,t'} \} \\
\text{(iv) } PS = \{ CG^K_{tel} + \varphi_{w,t'} \} \\
\text{(v) } K' = K \text{ in all other respects}
\end{bmatrix}
\]

This is not the result that we want; (ii)–(iv) in (30) indicate that RhIs add nothing to the relevant discourse components, which means they neither commit to a proposition nor raise an issue to the Table. One may think that this is where pragmatics comes in. In RhIs, the speaker dares to utter imperatives without any contribution to the discourse (with some violations of conditions of ordinary imperatives), which leads us to interpret imperatives as rhetorical utterances via. inferences. However, if so, it is not clear why and how the negated meaning is derived as a consequence of this inference. For example, a rhetorical question like “After all, do phonemes have a damn thing to do with language?” has a non-singleton set of possibilities, and in the rhetorical contexts, only the negated one can stay alive as a proposition which is compatible with the context, which thereby conveys the negation interpretation. In contrast, in RhIs, the standard approach must derive the negated meaning in some other way, since (30) has no alternative proposition to be interpreted.

We finally present data that may support the empirical validity of our disjunctive approach to Japanese imperatives. Interestingly, Japanese can form conditionals with the imperative morphology -e/ro, as shown in (31).

(31) a. Moshi ame-ga huri-no-de-ar-e (huranaini-no-de-ar-e),
    if rain-NOM fall-NMLZ-COP-be-IMP (not.fall-NMLZ-COP-be-IMP),
    geemu-wa okonawareru.
    game-TOP held
    ‘Whether it rains or not, the game will be held.’

    b. Moshi ame-ga huruni-shi-ro (huranaini-shi-ro), geemu-wa okonawareru.
    if rain-NOM fall-do-IMP (not.fall-do-IMP), game-TOP held
    ‘Whether it rains or not, the game will be held.’

As the English translation suggests, this conditional is interpreted as having a non-singleton set of alternatives like \{ it rains, it doesn’t rain \}. Although an analysis of this conditional is left as a topic for future research, the data above offers a possibility that the Japanese imperative morphology may not be a marker of imperatives but rather an alternative generating operator like Japanese ka (cf. Shimoyama, 2006; Szabolcsi, 2015; Uegaki, 2018).

5. Conclusion

Divorcing the discourse function from the resulting update for imperatives leads to a unified account of rhetorical and non-rhetorical speech-acts, providing further evidence for a view of discourse where rhetorical speech-acts are proposals for updating the common-ground.

There are still some remaining issues to be resolved. First, it is worth noting that not all kinds of predicates are allowed to be used as RhIs. For example, predicates like run, ask, and so on disallow rhetorical interpretation, while predicates like lie, say, and so on allow this interpreta-
tion. We therefore need to figure out what kind of predicates are available for RHIs. In addition, extending the current analysis to various languages other than Japanese (e.g. Turkish *Difficult Imperatives*, Demirok & Oikonomou 2019) will contribute to a better understanding of RHIs.

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A note on the representation and learning of quantificational determiners

Roni KATZIR — Tel Aviv University
Nur LAN — Tel Aviv University and ENS
Noa PELED — Tel Aviv University

Abstract. There is a tight, bidirectional connection between the formalism that defines how linguistic knowledge is stored and how this knowledge can be learned. In one direction, the formalism can be mapped onto an evaluation metric that allows the child to compare competing hypotheses given the input data. In the other direction, an evaluation metric can help the linguist to compare competing hypotheses about the formalism in which linguistic knowledge is written. In this preliminary note we explore this bidirectional connection in the domain of quantificational determiners (e.g., ‘every’ and ‘some’). We show how fixing an explicit format for representing the semantics of such elements – specifically, a variant of semantic automata – yields an evaluation metric, based on the principle of Minimum Description Length (MDL), that can serve as the basis for an unsupervised learner for such denotations. We then show how the MDL metric may provide a handle on the comparison of semantic automata with a competing representational format.

Keywords: quantificational determiners, learning, minimum description length, semantic automata.

1. Introduction

Early work in generative linguistics noted a tight, bidirectional connection between (a) the precise formalism that defines how linguistic knowledge is stored and (b) how this knowledge can be learned. The formalism can be mapped onto an evaluation metric – as in the simplicity metric of Chomsky and Halle 1968 (though other mappings exist, and below we will advocate a mapping that is somewhat different from that of early generative grammar) – that allows the child to compare competing hypotheses given the input data. This evaluation metric can then serve as part of a language acquisition device. And, in the opposite direction, a general evaluation metric can serve the linguist as a tool to compare competing hypotheses about the formalism in which linguistic knowledge is written (a point made in Halle 1978 and pursued further in works such as Baker 1979 and Dell 1981): two theories that are comparable in their ability to capture adult judgments might still make divergent predictions about learning when combined with a general evaluation metric. Early work on the bidirectional connection between representations and learning focused primarily on phonology (see especially Halle 1978 and Dell 1981), and to a lesser extent on syntax (see Baker 1979). But of course both the format for representations and the learning mechanism are important in semantics as well. In this paper we discuss the bidirectional connection between representation format and learning in semantics, focusing on the empirical domain of quantificational determiners (Q-dets): determiners of type <et, et.t >> such as ‘every’ and ‘some’. Since our focus is on learning, we will consider only Q-dets that might need to be acquired and stored and set aside expressions that may serve as Q-dets but are syntactically complex and therefore do not need to be lexically stored.

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We start, in section 2, by considering the mapping from representations to evaluation metrics, and ultimately to learners. We show how by fixing a representational format – for concreteness, a variant of *semantic automata* (SA; van Benthem 1986) – we obtain a learner from positive evidence alone. We do not wish to argue for SA (or for any other particular formalism for that matter) in this paper. Rather, our goal is to present and motivate the learning approach. Specifically, the evaluation metric will be that of *Minimum Description Length* (MDL; Rissanen 1978), which balances two competing factors: (a) the complexity of the grammar; and (b) its fit to the data. (By doing so, MDL combines the perspectives of two other evaluation metrics that have been used within the generative tradition: the simplicity metric of Chomsky and Halle 1968, which minimizes the complexity of the grammar, and the subset principle advocated in later work such as Dell 1981 and Berwick 1985, which maximizes the fit of the grammar to the data. See Rasin and Katzir 2016 for discussion.) The resulting learner – very much in line with Piantadosi et al. (2012), who use MDL for an unsupervised learner for a different representation – will be an unsupervised learner for the variant of SA that we use.²

In section 3 we then discuss the opposite direction, going from the MDL metric back to representations. Here we will attempt to compare SA to a different approach, which we will refer to as *building blocks* (BB). While the two approaches are hard to tease apart as the format for representing Q-dets, they are clearly different from one another, and finding a way to choose between them empirically can be significant. We will show how MDL might help in this task by outlining two kinds of cases in which the relative MDL scores assigned to certain Q-dets are different under SA and under BB, a difference that may translate into divergent learning-based predictions. Making the actual choice will be difficult, however, and in the present, preliminary (and highly programmatic) work we will have to content ourselves with a sketch of how a future comparison might be made.

### 2. From representations to learning

The present section shows how having an explicit format for storing knowledge provides a way to acquire such knowledge. As mentioned, we will illustrate this general point using lexical Q-dets (that is, Q-dets that need to be acquired and stored, rather than constructed compositionally): in all our examples, the learner will see a given scenario – for example, one where some boxes are on the shelf and others are not – and hear a sentence such as ‘gleeb boxes are on the shelf’, where ‘gleeb’ is the target Q-det and can be assumed to be lexical.

²See Clark 1996 for an earlier discussion of learning in the context of SA. Differently from our learner, Clark’s proposal relies on instruction (through the notion of a *minimally adequate teacher* from Angluin 1987), which includes negative evidence. See Steinert-Threlkeld and Szymanik 2019 for a different framework for representing and learning Q-dets, based on artificial neural networks (and which the authors suggest might be similar to SAs in certain ways). Like Clark (1996)’s learner and differently from ours, Steinert-Threlkeld and Szymanik’s learner relies on negative evidence.

Like Piantadosi et al. (2012) and Steinert-Threlkeld and Szymanik (2019), the present paper presents an implemented learner that can be run on various input data. There is also a body of work on theoretical learnability results in various paradigms. In addition to Clark 1996, work of this kind includes Tiede 1999 and Paperno 2011, both of whom discuss classes of Q-dets that are identifiable in the limit in the sense of Gold 1967. Paperno 2011 also considers learnability within the framework of PAC-learning (Valiant 1984) and reaches mostly negative conclusions about learnability within this paradigm, and Magri 2015 uses PAC-learning to motivate certain restrictions on possible Q-dets. See also Schafer 2019 for a PAC-learning analysis of the learning approach of Piantadosi et al. 2016, which, while not directly about Q-dets, is very close to this domain.
and in need of being acquired and stored. (The denotations of ‘box’ and ‘shelf’ are taken to be known.) Throughout, we will assume that the input available to the child consists entirely of positive examples, with no corrections or other forms of instruction. This is a conservative assumption, which makes the learning task hard, and we note that the input to actual children might be richer and possibly involve additional information, including certain forms of negative evidence. In particular, Rasin and Aravind (2020) have examined the input to the child in the context of the acquisition of the quantifier ‘every’ and found that, while the input included no systematic corrections or other forms of semantic negative evidence that could directly inform the child that ‘every’ denotes a universal and not the more inclusive existential quantifier, it did include pragmatic negative evidence that the child could potentially use.

Given familiar observations in the literature, we will focus only on Q-dets $Q$ for which the following two conditions hold.

(1) Assumptions about target Q-dets for the purposes of this paper:
   a. $Q(A)(B)$ can be determined based on $|A \cap B|$ and $|A \setminus B|$
   b. $Q$ is first-order

We make the assumptions in (1) for convenience. While these assumptions do correspond to various generalizations about attested lexical Q-dets across languages, it is far from clear that they adequately characterize the kinds of Q-dets that children can acquire: as far as we can tell there is not enough evidence currently available to evaluate such a claim.

In order to appreciate the significance to learning of using a concrete, explicit format for lexical storage, we start, in section 2.1, by probing intuitions about which denotations should be acquired and stored. We state the discussion simplistically in terms of lexical storage of Q-dets. We hope that the discussion can be restated within a proper morphological theory but will not attempt to do so within the present paper.

3We state the discussion simplistically in terms of lexical storage of Q-dets. We hope that the discussion can be restated within a proper morphological theory but will not attempt to do so within the present paper.

4See van Benthem 1986 for discussion of (1a). This restriction is often presented in terms of three familiar generalizations about monomorphic Q-dets: (a) that they (and also complex Q-dets) are conservative (that is, that $Q(A)(B) = 1$ exactly when $Q(A)(A \cap B) = 1$; see Barwise and Cooper 1981 and Keenan and Stavi 1986); (b) that they satisfy extension (that is, adding individuals to the domain beyond those already in $A$ and $B$ makes no difference to $Q(A)(B)$); and (c) that they are isomorphism invariant (if we map the domain isomorphically to another domain, $Q(A)(B)$ does not change). Assumption (1b) might seem less obviously justified typologically given the existence of the second-order Q-det ‘most’. See Hackl 2009 and Gajewski 2010, however, for arguments that ‘most’ is morpho-syntactically complex, composed of ‘many’ and the superlative morpheme ‘-est’ (a decomposition going back to Bresnan 1973).

5Hunter and Lidz 2013 present an experiment in which children acquired a novel conservative Q-det but not a non-conservative one (which is in line with (1a)), but see Spenader and de Villiers 2019 for experimental results (both with children and with adults) that do not show a learning preference for conservative Q-dets. Either way, for both assumptions in (1) further work is required in order to determine whether children can acquire generalization-violating lexical Q-dets. If they can, then the assumptions are too restrictive to adequately characterize the learner’s space of possible denotations.

It is also possible that the assumptions in (1) are not restrictive enough. In particular, while ‘many’ and numerals such as ‘two’ have quantificational uses, it has been argued that they are fundamentally adjectives and achieve their quantificational force compositionally, via type-shifting operations or composition with silent operators. See Landman 2004 for detailed discussion and defense of this position, as well as relevant references. If true, this would be compatible with a view on which the space of possible Q-dets is considerably smaller than the one assumed here – possibly to the point where the learning problem for Q-dets becomes trivial.

Given the above, the characterization of the space of lexical Q-dets in (1) should be taken as highly tentative, assumed as a concrete starting point but in need of much further work to clarify what Q-dets can actually be represented and acquired by children.
quired for a novel Q-det given a set of scenarios in the absence of such a format. We note that
intuitions are sometimes reasonably clear about when a given hypothesis is better or worse than
a competing hypothesis given a set of data, based on considerations of simplicity. However,
using these considerations within an actual evaluation metric requires being explicit about the
format of representations. This we do in section 2.2, where we fix as our representational for-
mat a variant of SA. (As mentioned above, it is not our goal to argue for SA. Rather, we wish
to present a particular approach to learning and to show how any reasonable representational
format can serve as the basis for such learning.) With an explicit format for representations
fixed, we return, in section 2.3, to the data and hypotheses from our initial discussion and
see how to talk about two notions of simplicity – simplicity of the grammar and simplicity of
the encoding of the data given the grammar – that jointly contribute to the appropriateness of
a grammar given the data. One way to combine the two notions of simplicity is through the
MDL evaluation metric, which we discuss in section 2.4. Finally, section 2.5 presents our MDL
learner.

2.1. Choosing between hypotheses

Suppose we hear the sentence ‘gleeb boxes are on the shelf’, with a novel monomorphemic Q-
det ‘gleeb’, in the context of various scenarios in which there are various boxes whose location
(on the shelf or not on the shelf) can directly be determined. In order to encode such scenarios,
let us assume that we have agreed on a way to enumerate the boxes in each case and that we use
1 to mark that a given box is on the shelf, 0 to mark that it is not, and # to mark that we have
reached the end of the encoding of the current scene. For example, \(<1,0,1,#>\) will encode a
scenario with exactly three boxes, where the first and third ones are on the shelf and the second
one is not. For our present illustration, suppose that the scenarios under consideration are the
following:

\[
\begin{align*}
(2) \text{ Different scenarios exemplifying ‘gleeb boxes are on the shelf’} \\
\text{a.} & \quad <1,1,1,1,1,#> \\
\text{b.} & \quad <1,0,1,1,0,0,#> \\
\text{c.} & \quad <0,1,1,1,1,1,1,#> \\
\text{d.} & \quad <1,0,0,1,1,1,0,1,0,0,#> \\
\text{e.} & \quad <0,1,0,0,1,0,1,1,1,1,#> 
\end{align*}
\]

What does ‘gleeb’ mean? Assuming a rich enough space of potential denotations such as the
one defined by (1), there will always be infinitely many hypotheses that are compatible with
any finite input data – here, with the scenarios in (2). However, some hypotheses will be better
than others. Let us look at a few examples.

First, ‘gleeb’ might mean ‘any number of’ (zero or more). Informally speaking, this seems
like a simple, natural kind of hypothesis. If we were to care only about the complexity of
the hypothesis (as was done under the simplicity metric of early generative grammar), this
hypothesis might be chosen. On the other hand, ‘any number of’ does not fit the observed data
very tightly: it is overly inclusive and would be true of any scene, while our (small) corpus in
(2) does not seem entirely random. For example, in each of the examples there are always at
least some boxes on the shelf, a fact that becomes an accident under the hypothesis that ‘gleeb’
means ‘any number of’.
Consider next the following hypothesis: ‘gleeb’ might mean ‘exactly 3 or 5 or 6 or 8’. This is a considerably more restrictive hypothesis than ‘any number of’, and it fits the data very well. If we were to care only about fitting the data (as was done under the subset principle), we might choose this hypothesis. On the other hand, ‘exactly 3 or 5 or 6 or 8’ feels like a very complex, unnatural hypothesis. If we were to see many further examples like those in (2), we might eventually want to adopt this restrictive but unnatural hypothesis. But given the small input sequence above, this seems unwarranted.

Finally, here is a better hypothesis than either of the above: ‘gleeb’ might mean ‘at least 3’. The hypothesis is still quite simple and natural, and yet it also fits the data quite well. It is a bit of a compromise on each front: it is somewhat less natural and simple than ‘any number of’, and it fits the data less tightly than ‘exactly 3 or 5 or 6 or 8’. But while less simple than ‘any number of’ it still seems reasonably simple, and while less restrictive than ‘exactly 3 or 5 or 6 or 8’ it is still reasonably restrictive, and of the three hypotheses under consideration it seems the most suitable overall given the data in (2).

The brief and informal discussion above suggests that balancing simplicity of hypothesis against restrictiveness (or goodness of fit to the data) might match our intuitions about the evaluation of hypotheses. It would be reasonable to consider it as a guiding principle for learning. But how do we measure simplicity and restrictiveness? To do that we will need to be more explicit about our representations than we have been so far.

2.2. Representing Q-dets using semantic automata

Here is one way to be explicit about representations, due to van Benthem (1986) and discussed further by Clark (1996), Steinert-Threlkeld and Icard (2013), and Szymanik (2016) among others. Recall from (1a) that we assume that for any lexical Q-det $Q$, the value of $Q(A)(B)$ can be determined based on $|A \cap B|$ and $|A \setminus B|$. For example, ‘some’ checks that the number of $A$’s that are $B$’s (represented as 1’s in the input sequence, as discussed above) is at least 1. And ‘every’ checks that the number of $A$’s that are not $B$’s (represented as 0’s in the input sequence) is 0. So we can represent monomorphemic Q-dets with a counting device that checks the cardinalities of the two sets. One kind of counting device that works in many cases – and that will suffice given our assumption in (1b) – is a finite-state automaton like the following.6

(3) An automaton for ‘at least 2’

\[ \begin{array}{c}
\text{start} & \overset{0}{\rightarrow} q_0 & \overset{1}{\rightarrow} q_1 & \overset{1}{\rightarrow} q_2 & \overset{0,1}{\rightarrow} q_F \\
q_0 & \overset{0}{\rightarrow} q_1 & \overset{1}{\rightarrow} q_2 & \overset{#}{\rightarrow} q_F \\
q_1 & \overset{1}{\rightarrow} q_2 & \overset{#}{\rightarrow} q_F \\
q_2 & \overset{0,1}{\rightarrow} q_F \\
q_F & & & & 
\end{array} \]

The automaton in (3) has four states, marked with circles and labeled $q_0$, $q_1$, $q_2$, and $q_F$. One

---

6See Hopcroft and Ullman 1979 and Sipser 2012 for introductions to the theory of automata. With van Benthem (1986) we take SA to be deterministic. However, as described below, we allow transitions that lead to an implicit sink state not to be encoded and not to count toward the costs associated with an automaton. We will omit the sink state and its transitions from our diagrams as well.

SA respect (1a) and therefore do not discriminate between input sequences based on the order of the 0’s and 1’s. This means that not every (deterministic) finite-state automaton is an SA. For example, an automaton that accepts the sequence $<1,0,#>$ but rejects $<0,1,#>$ is not a valid SA.
of these states, \(q_0\), is a start state, and another, \(q_F\) (marked with an extra circle), is an accept state. The automaton also has transitions between states: a 0 edge tells us where to go when we have a 0 in the input sequence (corresponding to an \(A\) that is not a \(B\)), a 1 edge tells us where to go when we see a 1 in the input sequence (an \(A\) that is a \(B\)), and a \# edge tells us where to go at the end of an input sequence.\(^7\) When we are at a given state and see an input symbol for which there is no written edge – for example, if we are at \(q_1\) and observe \# as the next input symbol – this should be thought of as an implicit transition to a sink state, not illustrated in the diagram, from which we never recover. The automaton accepts an input sequence if it can parse that sequence starting from the initial state, following the transitions according to the symbols in the input sequence, and ending at an accept state. In the present case, for example, we accept an input sequence consisting of a box that is not on the shelf, two boxes on the shelf, another box not on the shelf, and end of sequence. More generally, the automaton in (3) accepts any sequence with at least two boxes on the shelf.

2.3. Repeating hypothesis evaluation using SA

Let us repeat the hypothesis evaluation from section 2.1 but with the explicit representational framework of SA. As we will see, having such a framework will allow us to make concrete the notions of simplicity and restrictiveness, which we relied on informally above. First, consider again the hypothesis that ‘gleeb’ for (2) means ‘any number of’. The SA corresponding to this hypothesis is the following:

\[
\begin{align*}
q_0 & \xrightarrow{0,1} q_0 \\
& \xrightarrow{\#} q_F
\end{align*}
\]

We can now see what ‘very simple’ means: the automaton is very small. If we write this hypothesis as a computer program, using a programming language for SA, we will need very little storage space. In such a language, we will write each hypothesis as an encoding of the states and their transitions in a way that allows a reader to recover the original SA from the description.\(^8\) The length of this encoding, written as \(|G|\) and measured in bits, grows with the number of states and transitions. In (4), given how few states and transitions the SA has, it will be very short and cost only very few bits. So the grammar, \(G\), is small.

What about restrictiveness? Here we should check how well \(G\) describes the input data \(D\). Such a description is a sequence of instructions to \(G\) that generate \(D\). These instructions, like the encoding of \(G\), are provided in bits, and they depend on the optional choices in \(G\). The unique transition from a unary-branching state in the SA is cost-free: no instruction is needed to tell the SA to move along a given transition from a given state if this transition is the only one leaving that state.\(^9\) A binary transition costs one bit, specifying which of the two transitions is

---

\(^7\)The \# symbol is not part of the alphabet in van Benthem 1986.

\(^8\)The sink state and the transitions leading to it are recoverable from the rest of the SA and therefore do not need to be specified explicitly and do not contribute to the costs of encoding \(G\).

\(^9\)Implicit transitions to a sink state are ignored for the purpose of determining optionality and therefore do not contribute to the costs of describing \(D\) given \(G\).
to be chosen. (We assume that there is a key for making such choices. For example, perhaps the key specifies that if there is one 1-transition and one #-transition, then 0 encodes the former and 1 the latter.) If there are three transitions, additional bits are needed, and we will assume that in such cases two bits encode each choice. (Perhaps the key specifies that for ternary branching states, 00 encodes the 0-transition, 01 the 1-transition, and 10 the #-transition.) The sequence of instructions for a given input sequence – starting from the initial state, progressing through the relevant states along the way while generating the symbols in the input sequence in order, and ending in a final state – is the concatenation of the instructions at each state. In the case of (2a) (=< 1, 1, 1, 1, # >), for example, this will amount to five repetitions of the two-bit code for a 1-transition from q_0 followed by the two-bit code for a #-transition from q_0. For multiple input sequences, as in the whole of (2), the codes for the individual scenes are concatenated. We write D:G for the encoding of the input data D given the grammar G, and we write |D:G| for its length in bits.

In the case of (4), |D:G| is quite high, since all symbols are produced through choices from the ternary-branching q_0 and therefore cost two bits each. This is the consequence of G in (4) being overly inclusive, capable of capturing any input scene and therefore not telling the story of the particular D in (2) very well. We may expect that a more specialized SA, which is more selective in the sequences that it accepts, will allow at least some symbols in its accepted sequences to result from unary- or binary-branching transitions and therefore cost fewer bits. In this way, restrictiveness becomes a kind of simplicity: not of the grammar but of the description of the data given the grammar.

Next, consider again ‘gleeb’ as ‘3, 5, 6, or 8’, but now with the following representation:

(5) SA for ‘exactly 3, 5, 6, or 8’

Using (5), D:G is much smaller than with (4). To encode (2a) (=< 1, 1, 1, 1, # >), for example, we just need 1 bit for each of the first three boxes (since the branching at the relevant states—the first three ones—is all binary), and then 2 bits for the fourth box (since the branching at q_3 is ternary), and then 1 bit for the fifth box (binary branching), and then 2 bits for the termination of the sequence (ternary branching). So for four of the boxes we would pay just 1 bit instead of 2. On the other hand, |G| is big, as can be seen by considering the encoding of the automaton, which would need to specify a relatively large number of states and transitions.

Finally, ‘gleeb’ as ‘at least 3’ offers a good compromise, balancing between |G| and |D:G|:

\[\text{10(5) illustrates a potentially worrisome property of SA with respect to } D:G: \text{ differently from acceptance, which SA guarantee to be invariant to the order in which individuals are enumerated, } |D:G| \text{ does in general depend on the order of individuals. For example, the sequence } <0, 1, 1, 1, #> \text{ will cost 6 bits using (5), while } <1, 1, 1, 0, #> \text{ will cost 7 bits using the same SA.}\]
2.4. Minimum Description Length

The balancing of $|G|$ and $|D : G|$ that we just discussed is at the heart of the principle of Minimum Description Length (MDL; Rissanen 1978, with roots in Solomonoff 1964), where we balance the two quantities by minimizing their sum, $|G| + |D : G|$. The approach, which is also very closely related to Bayesian induction, has been used for various learning and prediction tasks, including for natural language, in the works of Horning (1969), Berwick (1982), Stolcke (1994), Brent and Cartwright (1996), Grünwald (1996), and de Marcken (1996), among others. It formalizes the intuition we discussed regarding good hypotheses for Q-dets, and in section 2.5 we will show what needs to be added in order to turn it into an implemented unsupervised learner. Before that, however, we wish to briefly review several motivations for MDL as a reasonable null hypothesis for how we learn.

One reason to consider MDL seriously as the child’s learning criterion is that it comes almost for free, as discussed in Katzir 2014. Grammars are real cognitive objects. They need to be stored in memory, storage that follows the specifications provided by our innate programming language, and this storage takes up space. The amount of space taken up by the grammar is $|G|$. Moreover, we use $G$ to parse inputs, and an encoding of this parse – an understanding of the input data $D$ according to $G$ – is $D : G$. If we store this information, the amount of storage for this part is $|D : G|$. The MDL quantity $|G| + |D : G|$, then, is simply the overall amount of storage for the grammar and for the data as understood by the grammar. This, in turn, makes the MDL quantity available to the learner with what seems like very minimal stipulation. In order to use MDL to learn, all that is needed is the ability to compare this quantity for a current hypothesis and for a neighboring one and gradually move toward grammars that minimize the overall storage space, as we will do in the next section. We are not aware of competing proposals for learning that require fewer stipulations.

A second reason to consider MDL seriously is that it appears to work well in practice, supporting unsupervised learners for various linguistic frameworks. Rasin and Katzir (2016), for example, use MDL to learn whole phonological grammars within Optimality Theory (Prince and Smolensky 1993), including underlying representations, markedness and faithfulness constraints, and the ranking of those constraints. Rasin et al. (2018, 2019) provide a similar MDL learner for phonological grammars within rule-based phonology. In semantics, Piantadosi et al. (2012) use MDL for an unsupervised learner in a representational framework that is similar to one that we will consider below.\footnote{One way to think about the first two reasons above – an admittedly very speculative perspective, but one that combines the two considerations in a natural way – is in terms of evolution. If MDL is indeed as non-stipulative as suggested, the burden that it imposes on evolution is minimal. Evolution would need to provide a representational format that allows grammars to be stored and to be used for parsing inputs, but this much is presumably shared by most theories. Beyond that, only very little additional machinery would need to evolve to support MDL learning. Moreover, since MDL is such a general metric, it could have evolved at a stage in which the format for representing knowledge was different – perhaps much simpler – than in modern humans. Note that the same cannot be said for
A third reason for considering MDL seriously is that its balancing of $|G|$ and $|D : G|$ seems to be in accord with the behavior of human participants in lab experiments. In particular, MDL – like the closely related Bayesian approach, which similarly balances the naturalness of hypotheses and their fit to the data – matches empirical results about generalization in lexical acquisition (Xu and Tenenbaum 2007), causation (Sobel et al. 2004), visual chunk detection (Orbán et al. 2008), and elsewhere.

2.5. An MDL learner

We now turn to an implemented unsupervised learner for Q-dets based on the MDL evaluation metric. All that is needed in order to turn the metric into a learner is the ability to read the input data $D$ and search the space of possible Q-dets for the grammar $G$ that minimizes the sum of $|G|$ and $|D : G|$. In general we cannot do this by brute force – the search space is too big. However, there are good, general optimization procedures that can handle complex search spaces. The learner that we discuss here uses *simulated annealing* (Kirkpatrick et al. 1983). We start from an initial grammar – the one for ‘any number of’ – and proceed by comparing the current grammar $G$ to a neighboring grammar $G'$ (derived from $G$ by certain simple operations) at each step. 12 If $G'$ is better than $G$ in terms of description length, we switch to $G'$. If it is not, we might still switch to $G'$, depending on a random draw and on how much worse $G'$ is and how far along in the search we are – the worse $G'$ is and the further along we are, the less likely we are to switch. 13

Here are some snapshots from a simulation in which $D$ consists of 100 sequences conforming to ‘between 3 and 6’.

(7) Snapshots from a sample run for ‘between 3 and 6’

a. Initial hypothesis

![Diagram of initial hypothesis]

$|G_0| = 18, |D : G_0| = 3,954, |G_0| + |D : G_0| = 3,972$

b. Step 8

12 To simplify the search, we only consider SA in which transitions are of the following kinds: (a) loops from some state $q_i$ to itself; (b) transitions from $q_i$ to $q_{i+1}$; and transitions from $q_i$ to $q_F$. Transitions of the first two kinds are always labeled with either 0 or 1, and those of the third kind are always labeled with #. This choice rules out certain potential Q-det denotations but as far as we can tell does not affect the general discussion.

13 The probability of switching to a worse $G'$ is based on a temperature parameter, which decreases as the search progresses. In the examples mentioned below, the initial temperature is 100, the cooling factor by which the temperature is multiplied after each step is 0.99, and the threshold temperature for stopping the search is 1. For each simulation 64 annealing processes were run, and the result with the lowest MDL score of all runs was taken as the final SA. The code for the learner is available at https://github.com/taucompling/semantic_automata.!
The initial hypothesis, as mentioned above and shown in (7a), is the one for ‘any number of’, which is simple, overly inclusive, and very different from the target grammar. Gradually, hypotheses start moving toward the target grammar. $G_8$, shown in (7b) and representing ‘at least 1’, is already a small improvement: while it has more states and transitions than $G_0$ (so $|G_8| > |G_0|$), $|D : G_8| < |D : G_0|$ because the branching at $q_0$ of $G_8$ is only binary and not ternary. This results in a shorter encoding length for the first 1 and every 0 before it, each of which will now cost just one bit rather than two. Iteration 62, shown in (7c), is a further improvement, with $G_{62}$ representing ‘at least 3’. For a small increase in $|D : G|$, $|D : G|$ decreases significantly: the branching in the first three states is now binary, which allows much more of each input sequence that conforms to the Q-det to be encoded using one bit rather than two per input element. $G_{75}$, shown in (7d), also corresponds to ‘at least 3’, though with a worse MDL score, illustrating how simulated annealing can sometimes move from better hypotheses to worse ones. This particular sub-optimal hypothesis is not maintained for long, however, and at iteration 86, shown in (7e), the search has already reached the correct automaton.
Here is a similar run with ‘none’, again with $D$ consisting of 100 sequences conforming to the Q-det (which, in the present case, means sequences of zeros followed by #).

(8) Snapshots from a sample run for ‘none’

a. Initial hypothesis

\[
\begin{array}{c}
q_0 \\
1 \\
0 \\
\hline
q_F
\end{array}
\]

$|G_0| = 18, |D : G_0| = 6,928, |G_0| + |D : G_0| = 6,946$

b. Step 3

\[
\begin{array}{c}
q_0 \\
0 \\
1 \\
# \\
\hline
q_1
\end{array}
\]

$|G_3| = 31, |D : G_3| = 6,928, |G_3| + |D : G_3| = 6,959$

c. Step 6 (Final hypothesis)

\[
\begin{array}{c}
q_0 \\
0 \\
# \\
\hline
q_F
\end{array}
\]

$|G_6| = 13, |D : G_6| = 3,464, |G_6| + |D : G_6| = 3,477$

This concludes our sketch of an unsupervised MDL learner for SA. We showed how fixing an explicit format for stored representations immediately yields an evaluation metric, based on the principle of MDL, that can serve as a central component of an unsupervised learner. Our goal was not to argue for the specific format that we used here (or any other particular format) but rather to highlight the mapping from explicit formats to an MDL learning criterion, a criterion that we suggested has certain appealing properties and that we believe makes sense as a starting point for modeling learning in humans.

3. From learning to representations

In the previous section we saw how fixing an explicit format for stored representations yields an evaluation metric, using the principle of MDL, that can then be used for an unsupervised learner. The present section shows the opposite direction: how, with a general criterion such as MDL, one can reason about formats for stored representations.

3.1. The idea

An observation due to Halle (1978) is that with a general approach to learning we can take two competing theories of representation and compare them using their learning-based predictions. This idea was explored further in work by Baker (1979) and Dell (1981), but that work relied on the simplicity metric of early generative grammar that minimized $|G|$ alone. That metric did not work – by focusing only on $|G|$ it led to overly general grammars, as noted by Dell (1981)
and some of the conclusions of that work do not carry over to balanced learning criteria such as MDL. But the idea was valuable, and we can revisit it now using MDL: given two theories of representation we can consider the MDL predictions of both and see whether the predictions of one of the theories are better than those of the other in how they match the learning behavior of humans.\footnote{Emphatically, the goal is not to see which of the two theories yields better compression of the input data, a measure that as far as we can see is irrelevant to the evaluation of the theories.} Theory comparison using MDL has been discussed in Katzir 2014 and Rasin and Katzir 2015, 2020, as well as Piantadosi et al. 2016. Here we will show a schematic outline of how such a comparison might be made in the empirical domain of Q-det denotations. Our goal is to show how different representational formats make different Q-dets costly or cheap in terms of MDL. We will not, however, be able to perform an actual comparison and make a choice between formats in the present paper.

3.2. Building blocks

In section 2 we discussed one representational format, namely our variant of SA. In what follows we will try to compare that framework with the following alternative, which we will call building blocks (BB), an approach loosely inspired by Keenan and Stavi (1986) and assumed in various later works on Q-dets (see, e.g., Hackl 2009, Piantadosi et al. 2012, and Katzir and Singh 2013). In BB, the representational framework provides various primitive operators and a grammar – in the toy example in (9), which we will assume for the discussion below, a context-free grammar – that determines how these primitives may combine.\footnote{A question that arises but that we will not be able to discuss here in any detail is how a BB grammar might relate to the grammar of morpho-syntax. For the present discussion we will assume that BB allows a complex structure to be written also for elements that appear to be morpho-syntactically simplex.}

(9) Sample BB grammar

\[
\begin{align*}
Q_{\text{det}} & \rightarrow Q \text{ Num} \\
Q & \rightarrow \neg Q \mid Q \text{ Con} Q \mid Q_{\text{basic}} \\
\text{Num} & \rightarrow \text{ Num} \text{ Con} \text{ Num} \mid \text{ Mod} \text{ Num}_{\text{basic}} \mid \varepsilon \\
Q_{\text{basic}} & \rightarrow \forall \mid \exists \\
\text{Con} & \rightarrow \wedge \mid \vee \\
\text{Mod} & \rightarrow \text{ exactly} \mid \text{ at least} \mid \text{ at most} \\
\text{Num}_{\text{basic}} & \rightarrow 0 \mid 1 \mid S \text{ Num}_{\text{basic}}
\end{align*}
\]

In the – highly simplistic – BB grammar in (9), Q-dets are built out of a quantificational subtree ($Q$, which is built as a boolean combination of existential and universal quantifiers) and a numerical subtree ($\text{Num}$). In the numerical subtree, multiple numerals can be represented, each with its own subtree. All numerals other than 0 and 1 must be generated through applications of the successor function $S$ (for example, 2 can be represented as $S 1$ or as $S S 0$). Here for example is a derivation tree for a Q-det for ‘exactly 2 or exactly 5’ using (9).

(10) Derivation tree for ‘exactly 2 or exactly 5’
Note how we build this tree by multiple applications of grammar rules, including multiple applications of the successor function in the two relevant subtrees to get the numerals 2 and 5. These multiple and separate applications of the successor function in the two subtrees will be significant for the comparison of BB with SA.

As with SA, we will focus on BB as a format in which lexical Q-dets, which need to be learned and stored, can be written. The example above, for example, will interest us only if the Q-det that it expresses appears on the surface as simplex – e.g., `gleeb` – and does not reveal its internal structure to the learner.

3.3. Outline of a possible comparison

Semantic automata and building blocks are very different representational formats. The choice between them seems meaningful and should be an empirical matter rather than one of theoretical taste. However, it is not easy to choose between them based on adult judgments alone. The present subsection outlines how MDL-learning might help, though as mentioned in the introduction we will only be able to provide a sketch of what a future comparison might look like.

The key to our comparison of the two frameworks will be the following observation, which we will make more concrete shortly. With SA, \( G \) grows with the highest cardinality that the Q-det cares about. Distinctions below that cardinality matter very little. With our grammar for BB, on the other hand, \( G \) may grow based also on distinctions below that highest cardinality.\(^{16}\) We can therefore look for a pair of Q-dets, \( Q \) and \( Q' \), that care about the same highest cardinality and have the same \( |G| \) according to SA but not according to BB. And we can look for an input \( D \) that is ambiguous between the two Q-dets and results in the same \( |D : G| \) with both.\(^{17}\) SA will predict that subjects exposed to a \( D \) of this kind will show no preference between \( Q \) and \( Q' \) (since both result in the same \( |G| + |D : G| \)) while BB predicts that such subjects will show a preference (specifically, for the Q-det that has a smaller \( |G| \) under BB). Below are sketches

---

\(^{16}\)What matters for the present outlined comparison is the ability to share parts of the representation of numerals. SA have this ability, and the specific grammar for BB that we use does not. One can devise different BB grammars in which sharing is possible, for example by using the kind of multi-dominance structures that have sometimes been used in the syntactic literature (see McCawley 1982, Wilder 1999, and Bachrach and Katzir 2009, among others). The present comparison, then, concerns structure sharing rather than SA vs. BB per se. For presentational convenience we will keep discussing it in terms of the two representational frameworks.

\(^{17}\)To complete the discussion one needs to specify how \( |D : G| \) is computed within the two frameworks. For SA this seems straightforward, as we discussed above, since each SA specifies a way of parsing inputs. BB does not tell us how to parse inputs and thus makes it less clear how to compute \( |D : G| \). Here we will assume that \( |D : G| \) for BB is computed by translating a given Q-det into an SA for purposes of processing.
of two cases where such comparisons might be made.  

3.3.1. Q-dets for ‘all of exactly \(n_1\) or exactly \(n_2\)’

First, consider a Q-det ‘gleeb’ denoting ‘all of exactly \(n_1\) or exactly \(n_2\)’ for some \(n_1 < n_2\), which we will write as \(\forall [n_1 \lor n_2]\). For ‘gleeb’ meaning \(\forall [2 \lor 5]\) (that is, ‘all of exactly 2 or exactly 5’), for example, ‘gleeb boxes are on the shelf’ will be true if there are exactly two boxes or exactly five boxes and if all those boxes are on the shelf; the sentence will be false otherwise. With BB, Q-dets of this kind will be represented using a tree with two numerical subtrees, similarly to the two subtrees in the representation of the slightly different kind of Q-det in (10) above. If \(n_1\) grows or \(n_2\) grows (or both), so will \(G\). With SA, on the other hand, only \(n_2\) affects the size of \(G\). Different \(n_1\)’s change the shape of \(G\) but not its size. For example, the SA for \(\forall [2 \lor 5]\) in (11) has a different shape from the SA in (12) for \(\forall [3 \lor 5]\), but the size of the two automata is the same. As to \(|D : G|\), note that any individual input sequence (a single sequence of 0’s and 1’s followed by #) that conforms to a Q-det of this kind will always be the same: exactly 1 bit. This is so since, as can be seen from the SAs in (11) and (12), producing a licit sequence with such SAs requires exactly one, binary choice (exiting \(q_2\) in (11) and exiting \(q_3\) in (12)), while all other transitions are from unary-branching states and cost nothing.

18 Other, more roundabout comparisons are also possible. For example, instead of comparing \(Q\) and \(Q'\) directly (through \(D\) that is ambiguous between both), it might be more convenient to look at how each of the two Q-dets compares to a third one, for example the simple but non-restrictive \(Q_0 = \text{"any number of"}\). Assuming that \(Q\) and \(Q'\) are complex but restrictive, MDL will prefer them to \(Q_0\) if the input – here, not necessarily the same \(D\) for the two Q-dets – is sufficiently large (in which case the benefits of the restrictive Q-dets in terms of \(|D : G|\) will outweigh their disadvantage in terms of \(|G|\) but not if it is very small (in which case \(|G|\) will play a bigger role than \(|D : G|\)). The amount of data that warrants moving from \(Q_0\) to either \(Q\) or \(Q'\) depends, among other things, on the relative size of the two Q-dets, and if they have the same size under SA but different sizes under BB, we may again obtain divergent predictions for the two frameworks. The precise predictions in such cases, however, are somewhat more involved than in the case of a direct comparison of \(Q\) and \(Q'\) (in part because of the need to factor in \(|D : G|\) under \(Q_0\) for inputs corresponding to \(Q\) and to \(Q'\), and we will set such comparisons aside in what follows.  

19 Such Q-dets are of course strange from a typological perspective. We know of no language that lexicalizes a Q-det of this kind. However, the restrictions in (1) make such Q-dets possible, and both SA and BB can represent them. If these are indeed possible lexical Q-dets – as might perhaps be tested in artificial grammar learning experiments – a separate account would be needed to explain why they are typologically unattested.
The above suggests a way to use Q-dets for $\forall[n_1 \lor n_2]$ to compare SA and BB. Consider two Q-dets, $Q = \forall[n_1 \lor n_2]$ and $Q' = \forall[n'_1 \lor n_2]$, with $n_1 < n'_1 < n_2$, and consider an input $D$ consisting of zero or more sequences of $n_2$ 1’s followed by #. In the case of $\forall[2 \lor 5]$ and $\forall[3 \lor 5]$, for example, one possible $D$ is $<1,1,1,1,1,#>$. Such a $D$ is ambiguous between $Q$ and $Q'$ (among other hypotheses). According to SA, $Q$ and $Q'$ are equally good hypotheses given the data: as just discussed, the two automata are of equal size, while $D : G$ consists of exactly one bit per sequence in both cases, so $|G| + |D : G|$ is the same for both. According to BB, on the other hand, $Q$ is better than $Q'$ given $D$: $|D : G|$ is still the same for both, but now $|G|$ is smaller for $Q'$ since $n_1 < n'_1$. So all things being equal, SA predicts that Subjects who are exposed to $D$ will show no preference between $Q$ and $Q'$ while BB predicts that such subjects would prefer $Q$ to $Q'$. Probing such a preference experimentally may of course be difficult – the distance between the comparison just sketched and an actual experiment is big. Still, the expected difference in preferences illustrates the ability of MDL to yield divergent empirical predictions from competing theories of representation.

3.3.2. Connected vs. non-connected Q-dets

We now turn to a sketch of a second comparison, one that concerns the difference between connected Q-dets – that is, Q-dets that refer to a single, contiguous sequence of integers (e.g., ‘5, 6, or 7’) – and non-connected Q-dets (e.g., ‘2, 5, or 7’). With BB, connected Q-dets can have a smaller $G$ than non-connected ones. This is so since, depending on the primitives available on the specific theory of BB, it might be possible to avoid explicitly listing intermediate values in the connected case, while those in the non-connected case need to be explicitly enumerated. For example, the connected ‘5, 6, or 7’ can be represented as ‘at least 5 and at most 7’, without referring to 6. For the non-connected ‘2, 5, or 7’ no similar compact representations are available. The two BB structures are shown in (13) and (14).

(13) BB representation for ‘between 5 and 7’ (connected)

(14) BB representation for ‘2, 5, or 7’ (non-connected)
Under the variant of SA presented earlier, on the other hand, no similar shortcuts exist for connected Q-dets. A connected Q-det such as ‘5, 6, or 7’ and a non-connected one such as ‘2, 5, or 7’ have automata of different shapes but of the same size, as illustrated in (15) and (16).

(15) SA representation for ‘between 5 and 7’ (connected)

(16) SA representation for ‘2, 5, or 7’ (non-connected)

Analogously to what we suggested for \(\forall [n_1 \lor n_2]\), we may consider two Q-dets, a connected \(Q\) and a non-connected \(Q'\) that have the same \(|G|\) under SA but not under BB (where \(|G|\) is smaller for \(Q\) than for \(Q'\)). And we can construct an input \(D\) that is ambiguous between the two Q-dets (among other hypotheses) and has the same \(|D:G|\) for both. All things being equal, SA predicts that subjects exposed to \(D\) will show no preference for either of the two Q-dets over the other, while BB predicts that such subjects will prefer \(Q\) over \(Q'\). (Again, probing this prediction experimentally may turn out to be non-trivial.)

4. Summary

How we write our stored representations and how we learn them are two important questions in any linguistic domain. Moreover, the two questions are intimately connected, as was noted in

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20Some suggestive evidence in this domain is provided by Chemla, Buccola, and Dautriche (2019), who show that connected quantificational denotations are easier to learn than non-connected ones (and see Chemla, Dautriche, Buccola, and Fagot 2019 for evidence for a similar connectedness bias in non-humans). However, their experiments were done within a paradigm that provides the learner with negative information, while the comparison that we outlined above relies on the learner encountering positive evidence alone. We can therefore not draw conclusions about the choice between SA and BB based on these results.
early work in generative linguistics. In this paper we outlined the connection in the domain of Q-det semantics. We showed how fixing an explicit format for stored representations – in our example, a variant of SA – yields an evaluation metric based on MDL, which we then turned into an unsupervised learner for Q-dets. We then considered the opposite direction, going from learning to representations, and outlined a possible comparison between SA and BB – two formats that differ from each other in substantial ways but that are both capable of representing Q-dets – based on MDL. We based the comparison on the observation that the two frameworks assign different MDL profiles to Q-dets in certain families. In particular, both the value of $n_1$ in ‘all of exactly $n_1$ or $n_2$’ (where $n_1 < n_2$) and the connectedness of Q-dets of a particular kind affect the $G$ part of the MDL metric $|G| + |D : G|$ under BB but not under SA.

In both directions, our outline is clearly very preliminary. For the first direction, from representations to learning, much further work is required to establish the actual input data that are available to the child, improve our understanding of the space of Q-dets that children can represent and learn, and compare children’s inferences to the predictions of MDL and other learning models. It also remains to be seen if and how MDL scales up to larger, more realistic corpora. In the other direction, from representations to learning, our sketch pointed at what we think is a promising direction for comparing competing frameworks, but we were not able to reach an actual comparison. Still, we hope that our outline is helpful in making explicit various issues involved in both directions and can be of use in future work in this domain.

References


Experimenting with subject alternatives for analysing generic sentences
Arnold KOCHARI — Institute of Logic, Language and Computation, University of Amsterdam
Robert VAN ROOIJ — Institute of Logic, Language and Computation University of Amsterdam
Katrin SCHULZ — Institute of Logic, Language and Computation, University of Amsterdam

Abstract. In this paper we argue that for the (probabilistic) interpretation of generic sentences of the form ‘Gs are \( f \)’ alternative groups, or kinds, of \( G \) play an important role. We describe the results of some experiments that empirically test this use of alternatives.

Keywords: Generic sentences, Experimental Semantics, Subject-term alternatives, Probability.

1. Introduction

Generic sentences are sentences of the form ‘Gs are \( f \)’ that, by their very nature, express useful generalisations. Thereby, the question of their truth, or acceptability, can be translated into the question of when we think that the expressed generalisation holds. A very natural and often explored approach to this question is the majority rule for the interpretation of generics (cf. Cohen, 1999). According to the majority rule a generic is true or acceptable in case the probability of a member of group \( G \) having feature \( f \) is high, (much) higher than \( \frac{1}{2} \),

\[
P(f|G) > \frac{1}{2}.
\]

Definition 1 A simple majority rule for generics.
A generic sentence ‘Gs are \( f \)’ is true in case \( P(f|G) > \frac{1}{2} \).

Thus, taking a generic like (1), we say that this sentence is true in case the majority of the birds fly.

(1) Birds fly.

This natural approach to the meaning of BP generics nicely accounts for the fact that not all birds need to fly in order for the generic to be true and still plays an important role in the literature on generic expressions.

Much ink has been spilled on the following ‘Port-Royal’ type of generics:

(2) a. Dutchmen are good sailors;
   b. Bulgarians are good weightlifters.

Intuitively, the above sentences are appropriate, although only a small percentage of Dutchmen are good sailors and only few of all Bulgarians are good weightlifters.

Cohen (1999) proposed that generics like (2a)-(2b) are true, because they should be interpreted differently than standard generics, namely in a relative way: (2a) is true iff compared to relevant alternative people in the 17th century (Frenchmen, Spaniards, Englishmen, and people from the Germanic countries), relatively many Dutchmen are good sailors. Similarly for (2b). In probabilistic terms this means that \( P(f|G) > P(f) \).

We would like to thank the audience of SUB 24 for their useful questions after our presentation of this material.

To be sure, Cohen (1999) also makes use of alternatives for feature \( f \), Alt(\( f \)), to determine the ‘domain’ of the probability function: \( P(f|G \cap \bigcup \text{Alt}(f)) > \frac{1}{2} \). We ignore those alternatives in this paper, however.

There exists an alternative formulation of the same idea. First, it is a fact of probability theory that $P(f|G) > P(f)$ iff $P(f|G) > P(f|¬G)$. Second, it is natural to think of $¬G$ as being an abbreviation of the set of individuals that are members of a group that can be thought of as an alternative to group $G$. If we refer to $Alt(G)$ as the set of groups alternative to $G$ (all incompatible with $G$), we can think of $¬G$ as an abbreviation of $\bigcup Alt(G)$. Thus, we end up with the following definitions of the truth-conditions of generic sentences.

**Definition 2** Truth conditions for generics with $G$-alternatives.

A generic sentence ‘Gs are f’ is ambiguous between an absolute and a relative reading. In its absolute reading the truth-conditions of Definition 1 apply. In its relative reading the generic is true in context $c$ in case for a contextually salient set $Alt(G)$ of alternatives to $G$ it holds that:

$$P(f|G) > P(f|\bigcup Alt(G)).$$

There is an important justification for assuming that generic sentences (also) have a relevant reading, and thus that the alternatives $Alt(G)$ matter for the interpretation of a generic sentence. Above, we have stated that generic sentences express, by their very nature, useful generalisations. This suggests that there is a close relation between our acceptance of generic sentences, on the one hand, and the way we learn generalisations, on the other (cf. Leslie, 2008). Much psychological research on learning was done before the cognitive revolution in psychology, in classical conditioning.

For animal learning, Rescorla (1968) observed that rats learn a tone (cue/cause)-shock (outcome) association if the frequency of shocks immediately after the tone is higher than the frequency of shocks undergone otherwise. This holds, even if in the minority of cases a shock actually follows the tone. Gluck & Bower (1988) and others show that humans learn associations between the representations of certain cues (properties or features) and outcome (typically another property or a category prediction) in a very similar way. Thus, we associate outcome $o$ with cue $c$, not so much if $P(o|c)$ is high, but rather if $\Delta P^o_c = P(o|c) - P(o|¬c)$ is high, where $\Delta P^o_c$ is known as the contingency of $o$ on $c$. As noted above, $\Delta P^o_c = P(o|c) - P(o|¬c) > 0$ if and only if $P(o|c) > P(o)$, i.e., the condition Cohen (1999) demands to be satisfied for relative readings of generics. In Tessler & Goodman (2019) and in van Rooij & Schulz (2019) it is hypothesised that (a strengthened version of) Cohen’s relative reading is the basic reading of generics. So, in contrast to Cohen (1999), we don’t think that the absolute reading is the default reading, but only a special case of the (strengthened version of the) relative reading. It is this that we want to test.

2. Empirical results on the role of $G$-alternatives

In the previous section we have argued in favour of the claim that subject-alternatives are relevant for the interpretation of a generic sentence of the form ‘Gs are f’. Moreover, we have argued that alternatives to the subject term $G$ are important in any case to learn the (inductive) generalisation. We provided independent evidence coming from the field of psychology of learning. In this section we will present the results of three empirical studies on the relevance of $G$- alternatives for the interpretation of generics.
2.1. The hypotheses that we will test

The central goal of this part of our research was to empirically test whether alternatives to the subject term $G$ do indeed affect the acceptability of a generic sentence. Specifically, we hypothesize that the probability with which the alternatives carry the relevant feature $f$ affects the acceptability of the generic.

**Hypothesis 1** *The acceptability of a generic sentence ‘Gs are $f$’ depends on the conditional probability of the feature $f$ given salient alternatives $G'$ of $G$.*

To test this hypothesis, we manipulate $P(f|G')$ and see whether we can observe an effect on the acceptability of the generic. Depending on whether or not this hypothesis is supported by the data, we can then test different approaches to the meaning of generic sentences that explain the result. For instance, if the observed acceptability is in line with Hypothesis 1, then we can test whether contingency is a good predictor for the acceptability of generic sentences.

**Hypothesis 2** *The acceptability of a generic sentence ‘Gs are $f$’ is given by the formula*

$$\text{acceptability of } 'Gs \text{ are } f' = P(f|G) - P(f|\bigcup\text{Alt}(G)).$$

In the following, we will present the results of two experiments testing the hypotheses formulated above. We were looking for a setup that allowed us to probe the intuitions of people concerning generics about a group of objects for which they do not have any prior knowledge. This will allow us to ensure that participants do not have prior beliefs about features typical for the objects they will see. A second objective was to control the $G$ alternatives that the interpreters were considering. This is the factor that we will manipulate in order to see whether it influences the acceptability of the generic sentence.

We presented participants with a picture-sentence verification task similar to that used in Bordanlo et al. (2016). The participants saw pictures with samples of fictive insect species from two Galapagos islands, Genovesa and Marchena (see Figure 1). Their task was to assess whether animals from one of the islands, Genovesa, could be described with a given sentence. All sentences were generics stating that the species from Genovesa – our target group $G$ – has a particular feature having to do with their colouring – our target feature $f$. We controlled the conditional probabilities $P(f|G)$ that the participants of the studies assigned by manipulating how many of the animals $G$ in the sample form Genovesa showed the particular colouring pattern $f$. The second sample from Marchena served as contextually salient alternative. By manipulating the frequency of insects with the relevant feature in this group we controlled $P(f|\bigcup\text{Alt}(G))$, which we will denote from now on by $P(f|\bigcup\text{Alt}(G))$.

We presented pictures in two conditions. In the non-contrastive condition an equal number of insects (80%) in both samples had the relevant feature $f$ (see Figure 1). Thus, in this case $P(f|G) = P(f|\bigcup\text{Alt}(G))$. In the contrastive condition, none of the insects in the sample from Marchena (the salient alternative) had the feature, while 80% of the insects from Geneva (the target $G$) had the feature $f$ (see Figure 2). In other words, in this condition $P(f|G) = 0.8$ and $P(f|\bigcup\text{Alt}(G)) = 0.2$.

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3The names of the islands are real. The participants were also shown a map of the Galapagos islands with the location of the islands. We chose animals instead of, for instance, manipulating the clothing of people, because the colouring of animals would not be perceived as an accidental feature of the observed individuals.
Based on Hypothesis 1, we expect that the strong difference of $P(f|\text{Alt}(G))$ between both conditions should have a significant effect on the acceptability of the generic sentences. Hypothesis 2 predicts that the judgments of acceptability people give for the generics should correspond to the contingency or the relative difference of feature $f$ given group $G$.

2.2. Study 1

In the first study we used a within-subjects design. All participants gave an acceptability score to one sentence in the contrastive condition, one in the non-contrastive condition and one filler sentence. Each question was presented with a different animal species (spiders, frogs or bugs). Below the two samples, a generic sentence was given that always described the species from Genovesa. The participants were asked to judge on a scale from 0 to 5 whether the generic sentence was acceptable given the provided data (e.g., "Can you say the following to describe Tree Frogs from Genovesa?", see also Figure 3). They gave a response by dragging a slider as depicted in Figure 3. They could adjust their response with an accuracy of two decimals, so they...
Based on Hypothesis 1, we expected a significant difference in the judgments of acceptability for both conditions. Hypothesis 2 claims that the judgments of acceptability people give for the generics should correspond to the contingency of feature $f$ given group $G$. In terms of proportions this measure predicts that the acceptability of a generic should increase if feature $f$ becomes more distinctive for the group $G$. Applied to the two conditions distinguished here we would expect that the generic is significantly more acceptable in case of the contrastive condition than in the non-contrastive condition. The measure of contingency also makes precise numerical predictions for the acceptability of generics. However, these predictions need to be translated into the scale presented to the participants in the study, because the range of the contingency function does not match the scale presented to the participants of the study: the contingency function ranges between $-1$ and $1$, whereas the scale the participants saw let them grade the acceptability of the sentences between 0 and 5. We used a linear transformation to map their responses directly onto the range $[-1,1]$ of the contingency function. Thus, 0 on the scale corresponds to a contingency of $-1$, 2.5 to a contingency of 0, and 5 to a contingency of 1. If we apply this linear transformation to the conditions that the participants of our study saw, Hypothesis 2 predicts that in the non-contrastive condition the contingency of the generic is 0, thus the participants should move the slide to around 2.5 on the given scale. In the contrastive case the contingency is $P(f|G) - P(f|Alt(P)) = 0.8 - 0 = 0.8$. This corresponds to the value 4.5 on the scale the participants saw. Given that there will be variation in how participants interpret the scale, we did not expect exactly the values predicted by the measure of contingency. However, the general proportional prediction described above should be visible in the data.

2.2.1. Method

**Materials & procedure**  We used pictures of three different animal species (Tree Frogs, Hide Beetles, Jumping Spiders). For each species we designed a picture in the contrastive and in the non-contrastive condition. All the pictures contained two samples, one with 25 animals of the species from Marchena, one with 25 animals from the species from Genovesa. For each species we had one corresponding generic sentence: "Hide Beetles from Genovesa have red wings", "Tree Frogs from Genovesa have yellow dots", "Jumping Spiders from Genovesa have green backs".
The participants saw each animal species once, one in the contrastive condition, one in the non-contrastive condition and a third species as a filler. This resulted in 3 experimental trials per participant. In the filler condition, participants saw a generic that claimed the group to have a feature that none of the animals had (for instance, it could be the picture on Figure 1 with the generic “Hide Beetles from Genovesa have green wings”) and, therefore, this sentence was clearly unacceptable. The filler condition was used to control whether participants completed the study in good faith: we excluded participants who gave a score above 1.5 in the filler condition as they likely did not pay attention in the other conditions either. The order in which the contrastive and the non-contrastive condition where shown was randomised. The filler always occurred last.

The study was implemented in Qualtrics. Participants started by reading the informed consent text and agreeing to taking part. They then read the instructions. Average time spent on the task was 143 seconds.

Participants Participants were recruited via Prolific.ac, an online platform aimed at connecting researchers and participants willing to fill in surveys and questionnaires in exchange for compensation for their time (Palan & Schitter 2018). We recruited native English speakers (British and American English) who reported no vision impairments. Eighty-two participants completed the task. Three participants were excluded: two because they did not give a response in one of the experimental items, one because they gave a score of 1.5 or above on the filler item. Thus, 79 responses were included in the analyses reported below.

Due to a mistake in the set up of the experiment, the participants were not forced to answer the filler questions. We therefore ended up with 27 participants who gave no response to the filler conditions. However, the slider was always at 0 by default, so these participants most likely simply agreed with the score 0 and therefore pressed ”respond” without moving the slider. For this reason, we still included these participants in the analyses.

2.2.2. Results

The mean score given by the included participants in the filler condition was 0.04 (SD 0.16); the mean score in the contrastive condition was 3.51 (SD 1.06); and, finally, the mean score in the non-contrastive condition was 2.88 (SD 1.50). We performed a Bayesian paired samples t-test to test for the strength of evidence in favour of the null hypothesis (no difference between conditions) as opposed to the hypothesis that the score given by participants should be higher for contrastive than for non-contrastive condition using JASP software (JASP team 2018) with default priors. This analysis resulted in $BF_{10} = 104$, meaning that the data was 104 times more likely under our hypothesis than under the null hypothesis. Thus, the first study does lend support to Hypothesis 1 claiming that alternatives to $G$ do affect the acceptability of a generic sentences and the general prediction of Hypothesis 2 about the tendency of this dependency: comparing situations in which a feature is distinctive vs. ones where it is not distinctive for a group, the generic has a higher acceptability in the situation in which the feature is distinctive.

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4 Since the material involved colours, the participants were required to have had normal vision of colours.

5 Excluding these participants did not make a difference to the results reported here.
In order to evaluate compatibility of the data with the actual given scores based on the Hypothesis 2, we investigated the 95% confidence interval (CI) around the mean in each condition (assuming normal distribution). We expected a mean score 4.5 in the contrastive condition, but observed 3.51 with 95% CI [3.27 3.74] which does not include the expected score. For the non-contrastive condition, we expected a mean score 2.5, but observed 2.88 with 95% CI [2.54 3.21] which again does not include the expected score, but does come close. Overall, while the scores come close to the expected ones, we cannot conclusively say that the observed values support our second hypothesis (but see the issues raised below in the Interim Discussion regarding the potential caveats of our approach).

Figure 4 depicts the difference between given scores in the contrastive and non-contrastive conditions for each participant (specifically, displayed is score in contrastive condition minus score in non-contrastive condition). We can see that not all participants uniformly gave higher scores to the contrastive as compared to the non-contrastive condition. In fact, there was a sizable proportion of participants who gave approximately the same score in two conditions, and even a small group that gave the non-contrastive condition a higher score than the contrastive condition. Thus, we seem to be observing different behaviour patterns by different participants. We will come back to this in Section 2.4.

Figure 4: Histogram of differences in scores between conditions: contrastive condition minus non-contrastive condition. Differences below -0.5 are marked in orange color, differences above 0.5 are marked in blue color. Orange bars thus indicate participants who gave a higher score in the non-contrastive condition, non-coloured bars indicate participants who gave a similar score in both conditions, and blue bars indicate participants who gave a higher score in the contrastive condition.

2.3. Study 2

The results of Study 1 supported the hypothesis that the score given by participants to acceptability of a generic sentence will differ for the case with an alternative present and the case with no alternative present. The generic ‘Gs are f’ becomes in general more acceptable in case the discussed feature f is distinctive for the group G. The results also partially confirm Hypothe-
sis 2: in the non-contrastive condition the generic was judged to be in between acceptable and unacceptable. In the contrastive condition the generic was on average rated to be acceptable, though not to the degree predicted by the contingency measure. In order to replicate the original finding, we administered the same task in a between-participant set-up: each participant saw only one of the two conditions (contrastive or non-contrastive) plus a filler item.

2.3.1. Method

Materials and procedure  The materials used in this study were the same as in Study 1 except this time the participants saw only either contrastive or non-contrastive condition and a filler trial (2 trials in total). Average time spent on the task was 128 seconds.

Participants  Participants were recruited via Prolific.ac with the same eligibility criteria. One hundred eighty-two participants completed the task. Three participants were excluded from the analysis because of a missing response to one of the items. Further 7 participants were excluded because of giving a score above 1.5 in the filler question. That left 172 participants for further analyses.

2.3.2. Results

The mean score given by the included participants in the filler condition was 0.07 (SD 0.23), in the contrastive condition 3.49 (SD 1.29; 95% CI [3.29, 3.68]), and in the non-contrastive condition 3.06 (SD 1.37; 95% CI [2.85-3.26]). We performed a one-sided Bayesian independent samples t-test to test for the strength of evidence in favour of the null hypothesis (no difference between conditions) as opposed to the hypothesis that the score in the contrastive condition is higher than the score in the non-contrastive condition using JASP software with default priors. We obtained $BF_{10} = 2.5$, meaning that the data was 2.5 times more likely under the alternative hypothesis than under the null hypothesis. While this is not particularly strong evidence in favour of the alternative hypothesis, the data does show the same pattern as observed in Study 1. The diminished difference between conditions is likely due to that in Study 1, having two cases to compare, the participants noticed that the second set of objects changed (i.e., animals from Marchena), and this in turn strengthened the perceived contrast.

2.4. Interim discussion

The results of both studies were in line with our Hypothesis 1: the probability of the feature $f$ given a contextual salient alternative did affect the acceptability of a generic sentence ‘Gs are f’. We also saw the direction of the dependence predicted by our theory confirmed: if $P(f|G)$ is substantially larger than $P(f|Alt(G))$ then the acceptability of the generic sentence is higher than in case there is no difference between both probabilities. We did not see the exact acceptability scores that the theory predicts (Hypothesis 2). In the non-contrastive condition, the theory predicts an acceptability of 2.5, while in Study 1 the average acceptability in this condition was 2.88 and in the Study 2 3.06 with 95% confidence intervals around mean not including the expected value in either case. In the contrastive condition, we predicted an acceptability
of 4.5 and observed an average of 3.51 in Study 1 and 3.49 in Study 2, again with the 95% confidence intervals around the mean not including the expected value.

Contrary to our expectation, the participants were not uniform in the scores they were giving - we observed large differences between participants’ behaviour, so it in fact it does not make much sense to look at the overall means as we set out when we started this project. However, this observation does not necessarily contradict the theory tested here. The predictions made by contingency as measure of the acceptability of generic sentences depends on which alternatives to $G$ the interpreter considers. We assumed that the setup of the study would lead the participants to consider the sample from Marchena as an alternative to the sample from Genovesa that the generic talked about. The theory predictions outlined above are only valid if the participants took the alternative into account. However, we cannot be sure that the participants really did take the sample from Marchena to be a relevant $G$ alternative. If they did not take any alternatives to the target group into account, the theory predicts the acceptability of the generic sentence to be equal to the conditional probability $P(f|G)$. Consequently, the acceptability value assigned by the participants would be 4.

To explore this possible interpretation of the data, we separated the participants of the Study 1 into three groups: those that assigned the same acceptability rating to the generics in both conditions (difference between scores in two conditions less than 0.5$^8$), those that judged the generic in the contrastive condition to be at least 0.5 points more acceptable and those who considered the generic at least 0.5 points less acceptable. 51% (N=40) of the participants in the first study did not give a substantially different score in two conditions, while 38% (N=30) considered the generic in the contrastive condition more acceptable than in the non-contrastive condition and 11% (N=9) of the participants took the generic to be less acceptable. We then looked at the scores given by participants in the first two groups$^9$. If Hypothesis 2 is correct but only participants in the group that gave a higher score to the contrastive condition took the sample from Marchena as an alternative to the sample from Genovesa, these participants should have given the scores predicted by Hypothesis 2 whereas the participants in the group that did not take into account the sample from Marchena should have given score 4 in both conditions (as discussed above). This was not the case. In the group of participants that gave a higher score in the contrastive condition than to the non-contrastive position, the average acceptability in the contrastive condition was 3.86 (SD 0.79; 95% CI [3.57, 4.14]) whereas the average acceptability in the non-contrastive condition was 1.72 (SD 1.22; 95% CI [1.28, 2.15]). Thus, even in this subgroup of participants, the scores come close to the ones predicted by theory, but we do not observe the exact values predicted by Hypothesis 2. The group that did not see a difference gave a mean score 3.35 (SD 1.18; 95% CI [2.98, 3.71]) in the contrastive and a mean score 3.4 (SD 1.22; 95% CI [3.02, 3.77]) in the non-contrastive condition.

$^6$Note that we report the mean values and statistics with the whole group despite this since we committed to an analysis plan before we collected data.

$^7$This was not possible for the second study since we used a between-participants setup in that case.

$^8$This is an arbitrary threshold that we chose. We assumed that a difference of 0.5 could arise from the participants trying to drag the slider to the same point on the scale, whereas larger differences would necessarily arise from intentional positioning of the slider at different points of the slider.

$^9$We will not discuss the participants in the third group which gave the non-contrastive condition a higher score than the contrastive condition further as we do not know why they behaved like that. They could have not understood the instructions or they could have changed their interpretation of the target sentence halfway through the experiment.
There are a couple of remarks we want to add about the discrepancies between the acceptability values predicted by the theory and the data obtained in the study. First of all, it is difficult to say how exactly the participants interpreted the scale that we asked them to use to indicate the acceptability of the generic sentences they saw. We tried to avoid the ambiguity by labeling the extremes of the scale verbally as 'not at all' and 'certainly', but cannot be sure what the participants did in case they were not sure about acceptability of the sentence (when it is neither acceptable nor unacceptable).

Depending on how the participants interpreted the scale, there might be also an issue with the way we interpreted the numerical values that our theory predicts. The range of the contingency function is the interval $[-1,1]$. We took this to mean that $-1$ corresponds to a completely unacceptable sentence, 1 to a sentence that is completely acceptable and 0 describing the turning point from not acceptable to acceptable. This is how we translated the values of the contingency function to the scale that we presented to the participants of both studies. To some extend this is also confirmed by the data. The obviously wrong filler items got average acceptability judgments that were very close to 0. However, there is no guarantee that even if the acceptability of generic sentences can be described in terms of contingency, as we proposed, the values are interpreted in the linear manner that we assumed. Maybe a 0 for contingency already means that we wouldn’t accept the sentence. To avoid such issues, we could show the participants a scale with numerical values from $-1$ to 1 instead 0 to 5 as we did here and see whether this affects their acceptability judgments for the same set of test data. This will need to be taken up in the follow-up research.

To sum up, in general the results support the theory proposed here, though we did not see exact scores that we expected. As discussed above, this could be because we did not transform the values from the theory to the scale seen by participants correctly. For this, more research in the future is necessary. What we can assess is in how far the theory explains the general tendencies in the data that we gathered, and in this respect the results are encouraging.

2.5. Study 3

The main goal of this final study was to test a different aspect of the theory developed in Section 1. We repeat here for reasons of convenience Hypothesis 2, which contains the heart of the proposal.

**Hypothesis 2** The acceptability of a generic sentence ‘Gs are f’ is given by the formula

$$\text{Acceptability of } 'Gs \text{ are } f' = P(f|G) - P(f|\bigcup \text{Alt}(G)).$$

So far, we have focussed on testing whether we can observe the predicted effects of manipulating the second argument of the measure of acceptability. We saw that indeed $P(f|\text{Alt}G)$ does affect the acceptability of generic sentences and also that the kind of influence predicted (acceptability goes up if $P(f|\text{Alt}G)$ goes down) can be observed. In this study, we focused on the first part of the measure: $P(f|G)$. Manipulation of this factor should, according to our theory, also have an effect on the acceptability of a generic. Roughly put, increasing this variable
should have a positive effect on the acceptability ratings.

As a side question, we also wanted to test with this study whether another new aspect of our proposal can be confirmed by the data. Note that the approach introduced in Hypothesis 2 also differs from the one described in Definition 2 in measuring the acceptability of generics in degrees instead of proposing cut-off points that define the limit between being or not being acceptable. For instance, if alternatives do not play a role, then Hypothesis 2 predicts a steady linear increase in the acceptability of the generic with growing \( P(f|G) \). In some sense, the data of the first two studies already speak against a clear cut-off point of 0.5, given that even though \( P(f|G) \) was 0.8 the acceptability ratings were not close to ceiling. Given that in this final study we consider different conditional probabilities \( P(f|G) \), the results should provide us with a clearer picture of whether the cut-off approach or the gradual change approach defended here come closer to reality.

In this last study, we used the same set-up as in the first two studies. The participants judged the acceptability of generic sentences with respect to the two conditions, the non-contrastive condition in which \( P(f|G) = P(f|\text{Alt}(G)) \) and the contrastive condition in which \( P(f|\text{Alt}(G)) = 0 \). The only difference is that now we varied \( P(f|G) \) between participants.

As Study 3 was a follow-up to the first two studies, this time we assumed from the start that there will be two groups of participants. Participants that do not take alternatives into account when evaluating the generic sentence (we will refer to this group as \( \text{noCon} \)) are predicted to use the conditional probability of the feature \( f \) given the group \( G \) as measure of the acceptability of the generic sentence. In this case, our theory predicts that in both conditions the acceptability of the generic should increase linearly with a growing conditional probability \( P(f|G) \). For participants that \( \text{do} \) take the presented alternative into account (group \( \text{Con} \)) the acceptability score should depend on \( P(f|G) \) and \( P(f|\text{Alt}(G)) \). In the contrastive condition, \( P(f|\text{Alt}(G)) \) is 0 while \( P(f|G) \) is not, so again the acceptability of the generic sentence should grow linearly with the increase in \( P(f|G) \). Furthermore, we predict that the acceptability ratings for this condition should overall be slightly higher (approximately 0.5 points) for the \( \text{Con} \) group that for the \( \text{noCon} \) group. In the non-contrastive condition, both \( P(f|G) \) and \( P(f|\text{Alt}(G)) \) are identical so the contingency of the sentence is 0. In this case, for the \( \text{Con} \) group there should be no effect of proportion on the acceptability of the generic sentence - the acceptability score should be the same independent of \( P(f|G) \).

\[ ^{10}\text{Cohen could argue that this is because some or all of the participants applied the relative reading of generics. However, notice that even after we split participants into groups according to whether they saw a difference between the two conditions, those that did not see a difference still did not give a ceiling acceptability score to the generic sentence. Furthermore, in the relative reading, Cohen would predict that still the generic should be completely acceptable in the contrastive condition and completely unacceptable in the non-contrastive condition, which is again not what we found.} \]

\[ ^{11}\text{The reason for this is a difference in how } P(f|G) \text{ counts for acceptability for participants that take alternatives into account and those that don’t. The acceptability rating of a participant that doesn’t take alternatives into account in the condition where 80% of the animals carries the relevant feature, for instance, should be } P(f|G) \times 5 = 4, 0. \text{ But a participant that takes alternatives into account should give in the contrastive condition a rating of } \frac{P(f|G)+1}{2} \times 5 = 4, 5. \]
2.5.1. Method

**Materials** This study had the same design as Study 1, but now we collected data for different proportions with which the animals possessed the relevant color feature. We used four proportions: 54%, 68%, 80%, and 92%. Furthermore, we also varied the distribution of the feature among the 25 animals that were shown to the participants: for each condition we used 3 pictures with different, randomly selected distributions of the feature over the presented animals.

Each participant had to make three judgments: she saw one picture in the contrast condition, one picture with the no contrast condition and one filler, all using the same frequency for the distribution of the feature. Each animal species was shown once. The order of the contrast/no contrast question was randomised, the filler was always shown as the third and last question.

**Participants** Participants were again recruited via Prolific.ac with the same criteria. 401 participants completed the task. Twenty participants were excluded because they gave inadequate responses to the filler items (score above 1.5). Six further participants were excluded because they gave all three conditions a score 0. 375 participants were thus included in the analyses reported below: 97 for frequency 54%, 89 for frequency 68%, 94 for frequency 80%, and 95 for frequency 92%.

2.5.2. Results

Because the condition in this study where $P(f|G) = 0.8$ is exactly the same as what we presented in Study 1, we start by inspecting the results for participants that saw this condition ($N=94$) to check for the robustness of the results we obtained there. For this group, the mean score in contrastive condition was 3.50 (SD 1.25), whereas the mean score in non-contrastive condition was 2.88 (SD 1.47). When split into groups, there were 32 participants (34%) who gave the contrastive condition a higher score (difference more than 0.5) than the non-contrastive condition and 58 participants (61%) who gave them the same score (difference less than 0.5). Both the averages and the proportions of participants in each group are close to what we observed in Study 1. Hence, these findings are robust.

As stated above, in this study we distinguish two groups of participants: group Con contains participants that found the generic more acceptable in the contrastive condition than in the non-contrastive condition; participants in group noCon did not give a different score in the two conditions. We split the participants into these two groups using the same criteria as we used in Study 1. There were 135 participants (36%) who gave a higher score in the contrastive condition (group Con). When collapsing across different proportions, this group gave a mean score 3.69 (SD 0.97) in the contrastive condition and a mean score 2.0 (SD 1.21) in the non-contrastive condition. There were 209 participants (55%) who gave the same score in two

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12 All sample-pictures contained 25 animals of one species, see Figure 3. Thus, for example, in the contrastive condition a proportion of 54% means that 14 out of 25 animals in the sample from Genovesa have the property and none of the animals in the sample from Marchena. In the non-contrastive condition in both samples 14 out of 25 animals would have the property.

13 As a consequence, the trials using 80% were a complete replication of the first study. We will come back to this in the discussion of the results.
conditions (group noCon). This group gave a mean score 3.2 (SD 1.26) in the contrastive and a mean score 3.18 (SD 1.25) in the non-contrastive condition. Finally, there were 18 participants (9%) who gave a higher score in the non-contrastive condition. The table in Figure 5 shows the results for the different probabilities split up according to the two groups that we distinguish.

| Condition          | P(f|Alt(G) = 0) | group Con |            | group noCon |            |
|--------------------|----------------|-----------|------------|-------------|------------|
| contrast,          |                |           |            |             |            |
| 54%                | 3.34           | 1.04      | 37         | 2.80        | 1.01       | 49         |
| 68%                | 3.67           | 0.69      | 35         | 2.81        | 1.32       | 43         |
| 80%                | 3.79           | 1.20      | 32         | 3.43        | 1.22       | 58         |
| 92%                | 4.06           | 0.81      | 31         | 3.59        | 1.30       | 59         |
| no contrast,       |                |           |            |             |            |
| P(f|Alt(G) = P(f|G)) | 54%            | 1.71      | 1.15       | 37         | 2.78       | 1.00       | 49         |
|                    | 68%            | 2.20      | 0.91       | 35         | 2.77       | 1.27       | 43         |
|                    | 80%            | 1.89      | 1.40       | 32         | 3.41       | 1.21       | 58         |
|                    | 92%            | 2.27      | 1.38       | 31         | 3.58       | 1.32       | 59         |

Figure 5: Results of study 3

To test our predictions, we conducted a Bayesian ANOVA with condition (contrastive vs. non-contrastive) and proportion (as an ordinal variable) as independent variables for each group separately. To evaluate whether a certain variable has an effect on the given scores, we compared a model including this effect with a model excluding this effect. For the group that gave the same score to both conditions (group noCon), we predicted an effect of proportion - the scores should linearly increase with increasing proportions. In the ANOVA analysis, we observed modest evidence against the effect of condition (BF_{Inclusion} = 0.2, given by the definition of the group), strong evidence for the effect proportion (BF_{Inclusion} = 13), and strong evidence against the interaction of condition and proportion (BF_{Inclusion} = 0.02). Thus, we do observe an effect of proportion. However, while the participants did give a higher score with increasing proportions, this increase does not seem to be equally present for all proportion steps. A post-hoc test comparing each proportion to the other ones showed that scores given for proportion 54% were not different from scores given for proportion 68% (BF_{10,U} = 0.16), and scores given for proportion 80% were not different from scores given for proportion 92% (BF_{10,U} = 0.22); for the other proportion pairs, we had evidence for the difference in scores. Thus, participants here did not seem to care about the difference between the lowest two proportions and the highest two proportions, exhibiting rather behaviour that would correspond to there being some sort of threshold between P(f|G) = 68% and P(f|G) = 80%.

For the group that gave the contrastive condition a higher score than the no contrast condition (group Con), we predicted an interaction between condition and proportion: the scores given by participants should linearly increase with increasing proportions in the contrastive condition, but they should be the same across proportions in the no contrast condition. In the ANOVA analysis, we observed extreme evidence for the effect of condition (BF_{Inclusion} = ∞), inconclusive evidence for presence or absence of the effect of proportion (BF_{Inclusion} = 0.8) and modest evidence against the interaction of condition and proportion (BF_{Inclusion} = 0.2). Hence, based on our analysis, here the predictions were not borne out - the effects of condition and proportion did not clearly interact. When inspecting averages for each proportion in the two conditions, there does indeed seem to be a gradual increase of the scores in the contrast condition in this
group, whereas in the no contrast condition there seems to only be a random fluctuation of the scores. But even if we focus only on the judgments for the contrastive condition, there is no evidence for an effect of proportion. It seems like the increase in scores was not consistently present for all participants (see Figure 6 for a depiction of the individual scores).

Figure 6: This plot depicts the difference between contrastive and non-contrastive condition (on the Y axis) for each of the 135 participants of the Con group (on the X axis). We grouped the participants by the proportion that they saw. We can see that it is not the case that there are mostly higher scores for higher proportions. NB: each participant saw only one proportion.

2.6. General discussion

All three studies that we reported on seem to confirm Hypothesis 1: for many participants the acceptability of a generic sentence ‘Gs are f’ depends on the conditional probability of the feature f given salient alternatives G’ of G. We also found evidence for the type of dependency predicted by our proposal: if the feature f is much more frequent given G than given the alternative G’, then the acceptability of the generic improves. Study 1 and study 2 did not confirm the exact acceptability scores predicted by the theory, but as discussed in Section 2.4, this might have to do with the particular methodology we used. In particular, our proposal for transformation of the scores in our task to those predicted by the theory might not be accurate.

With study 3, we wanted to investigate whether the predicted dependency on the absolute probability of f given G is also supported by empirical results. Based on the discussion in Section 2.4, we now immediately distinguished two groups within the participants: group Con consisted of participants that judged the generic more acceptable in the contrastive condition, while in group noCon were those participants that gave the same scores in the two conditions.

For the group noCon, the results of study 3 supported a dependence of acceptability on proportion: the acceptability increased with the probability \( P(f|G) \), independent of condition. But, as discussed above, we could not confirm the predicted linear increase in acceptability that Hypothesis 2 predicts. Instead, there was some evidence for an acceptability threshold between the second and third condition of proportion. This provides some evidence for threshold theories like the one of Cohen (1999), though the value of the threshold clearly seems to differ from the 50% threshold that Cohen proposes. Also the values below the threshold are not what one

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14 The reader might notice that in the 54% condition only one participant had a very large difference - 5, and there is no other participant in other proportions with such a large difference between the contrastive and the non-contrastive condition. One might think that maybe this participant is the reason why we do not observe an effect of proportion. But excluding this participant does not affect the results.
normally would expect. Even in the conditions with \( P(f | G) = 54\% \) and \( P(f | G) = 68\% \), the generics still were not clearly rejected, but on average still marginally acceptable. We need more empirical data, also for different conditions of proportions to be able to say whether we should prefer a threshold account and what form exactly it should take.

For group Con we could not confirm an interaction between condition and proportion. Note that the mean acceptability score given to the generic in the contrastive condition did steadily increase with growing conditional probability of the feature \( f \) given the group \( G \), and in a rate that comes close to what is predicted by the theory. However, statistically the result was not significant. Here, either the theory is wrong or perhaps our experiment was not tapping into the interpretation/significance of alternatives clearly enough to reliably detect the difference. One reason for this could be that this effect (i.e., the increase in scores due to increasing \( P(f | G) \)) is rather small, so our sample size of approximately 30-35 participants in each group is not large enough to detect it. In this connection, notice also the surprising low acceptability ratings of group Con for the non-contrastive condition. The theory predicts an acceptability value of 0 in this case, independent of \( P(f | G) \), which should correspond to a score 2.5 on the scale the participants saw in our study (with our transformation). However, in study 1 and for all four proportions in study 3, the given acceptability score was lower than that and varied quite a lot. We already discussed in Section 2.4 that a possible explanation might lie in the way people interpreted the scale on which they gave their judgments.

Let us turn to the relevance of the data from the group Con for the cut-off point hypothesis built into theories like the one proposed in Definition 2 in contrast to the gradual increase in acceptability that Hypothesis 2 predicts. As discussed above, for the group noCon there was some evidence for a cut-off point between \( P(f | G) = 68\% \) and \( P(f | G) = 80\% \). In contrast, for the group Con we do not see the same ‘jump’ in acceptability ratings between proportions. Instead, as discussed above, at least in terms of just the means there appears to be a linear increase of acceptability in the contrastive condition. From a theoretical point of view this observation is rather difficult to make sense of. Why should there be a cut-off point in case no alternatives are taken into account, while acceptability increases linearly in case alternatives do matter? Of course, we could easily propose an ambiguity with two possible readings of generics; one with threshold, one without. But that seems to be an awfully arbitrary difference between two readings of the same sentences. Before we take such a theoretical step we need more evidence that this difference is real. To conclude, our results do not support a clear threshold account, as, for instance, defended in Cohen (1999). But also the linear increase of acceptability with growing \( P(f | G) \) that Hypothesis 2 predicts is not completely supported by our data.

Finally, there is one more curious feature of the behaviour of participants in study 3. Even though the few datapoints we recorded do not allow us to test for it, notice that the size of group noCon appears to increase with growing \( P(f | G) \). Using the terminology of our proposal, the higher the absolute probability of \( f \) given \( G \) the less relevant alternatives to \( G \) seem to be. There is some evidence from related domains, as studies of causal judgments, showing that actually \( P(f | G) \) counts more for the acceptability of such judgements (Wasserman et al. 1993, Anderson and Sheu 1995). Using a measure that takes this into account and, for instance, weights \( P(f | G) \) more the larger this factor is, could explain the tentative observation just made. The higher \( P(f | G) \), the less the contrastive value \( P(f | Alt(G)) \) would count for acceptability,
and, hence, the smaller the difference between the contrastive and the non-contrastive condition. Consequently, more people would look like belonging to the group noCon instead of the group Con. Thus, if this tentative observation just made could be confirmed by a study suitable to test it, it might give us an important hint for how to improve the proposal made here.

3. Conclusions

In this paper, we discussed the relevance of alternative groups for the interpretation of generic sentences $Gs$ are $f$. This has led us to a first and preliminary formal description of the meaning of generic sentences, given in Definition 2. According to this approach, we have to distinguish two readings for generic sentences: a relative reading that does take alternatives to $G$ into account, and an absolute reading that does not. The proposal is basically that in Cohen (1999).

We motivated the relevance of the relevance reading of generics, and thus of alternatives to $G$, by linking this meaning to associative learning. Building on theories of learning from psychology, we formulated a new and final version of our approach. According to this proposal, acceptability of a generic ‘$Gs$ are $f$’ should be measured in terms of the strength of association of the group $G$ with the feature $f$. To have a concrete proposal that we could test, we used contingency to measure this strength of association. This proposal differed from the approach we formulated at the end of the first part of the paper in two important respects. First of all, it predicts the acceptability of generics to come in degrees. More concretely, this means that our proposal does not assume strict cut-off points for the truth or acceptability of generics. Secondly, the proposal assumes not two, but only one (context-dependent) reading for generic sentences. This reading is the relative reading of Definition 2. The reading can in certain circumstances – if the alternative set the interpreter assumes for $G$ is empty – collaps to the absolute reading of Definition 2.

In the second and main section of the paper, we reported on three studies that tested our proposal. In these studies participants were presented with a visual scene and asked to judge the acceptability of a generic sentence ‘$Gs$ are $f$’. We manipulated the presence of the alternatives and the frequency with which members of group $G$ carried feature $f$. The results allowed us to confirm the relevance of $G$-alternatives for the meaning of generic sentences in the population in general. We also observed some evidence for the correlation between acceptability of generic sentences and $P(f|G)$. However, not all particular predictions made by the proposal were borne out.

Interestingly, there seemed to be at least two groups of participants based on the acceptability scores they gave in different conditions. One group did seem to take into account the alternative to $G$, whereas another group did not seem to do it. This difference can be explained from the perspective of the theory tested here: some participants did not accept the presented alternative as salient and adopted an absolute reading of the generic sentence. But it also hints at a weak point of the proposal: it remains silent on the question what the relevant alternatives are that a speaker considers. Why is it that the alternatives that we presented were ignored by more than half of the participants?

Also, we did not obtain the exact acceptability scores in different conditions that the theory predicted. Here, the question of how we transform the values from the theory to the scores given by participants is relevant (see below). Finally, based on the scores given by participants
in study 3, one group of participants exhibited behaviour compatible with there being a certain threshold, albeit not exactly what is expected under Definition 1. All of these empirical observations call for further work on the theory proposed here, but also certain methodological questions need to be addressed by future research.

One aspect of the used methodology that is important to note is that we did not model sequential learning in our experiments. A central idea of the theory proposed here is that acceptability of a generic sentence is equated with the strength of association built based on the frequency with which the agent observed members of a group carrying a particular feature. However, we did not allow the learning of the association to observe these occurrences sequentially. Instead, we just gave the participants of the studies the information in one batch. It would be good if we found an experimental setup that modelled learning in a more natural way.

Another aspect of the methodology applied that we would like to improve on in future work is the way we mapped the responses we get from the participants to the very precise numerical values of the theory used. Whether our data does or does not correspond to theory depended largely on how exactly one transforms these scores. Note that it is rather unusual for experimental psychology to formulate predictions in terms of specific scores as we did here, because it is assumed that there is too much uncertainty about what people are doing to have such precise predictions; traditionally, only presence or absence of differences between conditions is tested instead. We believe that formulating and testing more specific numerical predictions is a good way to reduce the gap between theories like the one about the meaning of generics presented here and experimental findings with human participants. But we also realise that methodologically this presents a number of challenges that we haven’t solved completely yet.

Though the most pressing challenges for future work on the topic explored here are arguably methodological in nature – we need a solid empirical basis in order to direct further theoretical work – there are also a couple of interesting theoretical questions that we want to explore in future work. Just to mention one example, we picked contingency to measure associative learning. However, there are other measures of strength of association discussed in the literature. We should test those as well on the data-set gathered here and compare the predictions made with those of contingency.

References


How to trivialize uniqueness
Jan KÖPPING — Goethe-University Frankfurt

Abstract A new unified account for anaphoric and non-anaphoric (attributively used) definite descriptions is proposed that avoids making use of lexical ambiguities and the notion of minimal situations.

Keywords: definite article, uniqueness, anaphoricity, (minimal) situation.

1. Introduction

Definite descriptions can be used with and without antecedents, i.e., anaphorically and non-anaphorically (‘self-standing’). If they are used non-anaphorically, uniqueness effects arise, which are generally absent when they are used anaphorically. That is, a self-standing definite description is often understood as conveying that one and only one individual bears the property its restrictor expresses. Thus, (1a) suggests that there is exactly one (relevant) actor. Circumstances of evaluation where this is not the case are thus rejected. This uniqueness effect—i.e., the rejection of certain circumstances—does not arise when definite descriptions are used anaphorically. The definite description in (1b) does not seem to claim that there exists only one (relevant) actor but just relates back to the subject of the first sentence:

(1) a. The actor went broke.  
   b. Johnny Depp is in trouble. The actor went broke.

Either the presence of a uniqueness effect in one case or its absence in the other stands in need for some explanation. The only other option is to argue in favor of a lexical ambiguity, i.e., to deny that the definite articles in (1a) and (1b) are the same element. The latter has been done quite convincing for languages like German and Swiss German by Florian Schwarz (in Schwarz, 2009, 2012), while attempts to reconcile the conflicting observations by means of making use of minimal situations have been undertaken in situation theory (especially Elbourne, 2005, 2013; Kratzer, 2007). The gist of the latter sort of proposal is to amend the anaphoric use of definite descriptions to the self-standing use by describing anaphoricity as being mediated by very small, minimal, situations—in the case at hand, a situation just consisting of Johnny Depp—so that there is, in fact, only one actor.

This article argues that the definite descriptions in (1a) and (1b) are indeed the same lexical element, and that it is possible to make that claim without adopting the situation-based approach towards anaphoricity just sketched. Instead, a version of Irene Heim’s File Change Semantics

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1 I would like to thank the audiences in Frankfurt, Göttingen, Bochum, Vienna, and Osnabrück for helpful comments and suggestions, and especially Frank Sode and the editors of this volume for reading through the final manuscript. All errors in this article are mine.

2 Excluding predicatively used definites as in, e.g., Magnus Carlsen is the greatest chess player of all time.

3 There are some exceptions that can be explained in terms of relevance; i.e., a definite description can be understood as stating the uniqueness of a relevant witness of a property. This was already observed by Russell as can be witnessed by the following passage (emphasis in the original):

   Now the, when it is strictly used, involves uniqueness; we do, it is true, speak of “the son-of So-and-so” even when So-and-so has several sons, but it would be more correct to say “a son of So-and-so.” Thus for our purposes we take the as involving uniqueness. (Russell, 1905: 481)

(FCS) is proposed in which (i) her entailment requirement is done away with, but (ii) a novel formulation of the uniqueness condition is given.

This paper is organized as follows: Section 2 briefly reviews the notion of uniqueness with respect to situations that originated in early versions of situation theory that will later be adopted in order to account for uniqueness effects of self-standing definite descriptions. Section 3 then introduces a highly stylized version of FCS together with Heim’s Extended Novelty-Familiarity-Condition and discusses some shortcomings of the latter, especially the entailment requirement that gives rise to Heim’s Problem. Section 4 then introduces the adapted version of FCS that makes use of crucial features of both kinds of accounts, and shows how the novel formulation of the uniqueness condition is trivialized in the anaphoric use of definite descriptions and thus behaves exactly as needed. Section 5 sketches the prospects of the account.

2. Uniqueness with respect to situations

At least since the work done in situation theory (Elbourne, 2013; Kratzer, 2007; Schwarz, 2009, a.o.), non-anaphoric uses of definite descriptions are commonly accounted for by relativizing their descriptive content to situations. This leads to the notion of uniqueness with respect to a situation: If a definite description of the form the + NP is evaluated against a situation s, there needs to exist exactly one individual in s that bears the property expressed by NP in order for the use of the definite description to be felicitous. So, for example, the situation theoretical paraphrase of (1a) thus is (2):

(2) There exists exactly one actor x in s and x went broke in s.

This kind of approach fares much better than a standard relativization of descriptive content to possible worlds could because situations can vary in ‘size’ (i.e., spatiotemporal extension) and therefore be rather small. There is no need to claim that (2) can only be true if there exists a single actor in a complete world, which would raise the bar for using a definite description way too high.

But if a definite description is used anaphorically, such a paraphrase is not appropriate anymore. The intuitive interpretation can be phrased as in the simple (3), using the antecedent’s referent instead of the quantifying there exists exactly one actor x in s to paraphrase the contribution of the definite description in (1b).

(3) Johnny Depp went broke in s.

Elbourne (2005) tries to adapt the mechanism underlying the paraphrase in (2) to the use in (1b) by appealing to so called minimal situations. The idea, in a nutshell, is that situations are only so small as they need to be in order to make sentences true. Thus, to make the first sentence of (1b) true, only those situations are considered that contain nothing but the very individual

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4It has been claimed that worlds can be rather small as well, see Cresswell (1988) for a case in point. If one endorses such a view, nothing is gained by taking situations rather than worlds to be the prime parameter of evaluation.

5But even if situations are allowed to vary in size, the run-of-the-mill situation that makes sentences uttered in a conversation true is not so small that it just contains one single individual. Thus, (1a) usually is not readily accepted if it does not refer to the context of utterance.
contributed by the proper name—i.e., Johnny Depp⁶—and the property of being in trouble. The second sentence then is evaluated against those situations that make the first sentence true, hence, the definite’s descriptive content can only be checked against situations hosting nobody but Johnny Depp, the actor.⁷ Thus, the paraphrase in (2) indeed yields the desired interpretation, since it turns out to be equivalent to the paraphrase in (3) (wrt. the relevant situations).

But, as is pointed out most notably in Zweig (2006), the notion of minimal situations is haunted by deep problems, which is why it is not utilized to account for anaphoric uses of definite descriptions in all varieties of situation theory. For example, Schwarz (2009) uses situations in a more theory-neutral way⁸ and argues for a division of labor between a situation based theory of domain restriction (and hence self-standing uses of definite descriptions) and a dynamic (but not situation based) account of anaphoricity. To be concrete, he assumes the anaphoric use to be handled via coindexation of an additional anaphoric element in the definite description and its antecedent. The paraphrase of (1b) roughly is (4) (where \( x_1 \) is coindexed with Johnny Depp in the first sentence), which is equivalent to (3).

(4) There exists exactly one/an actor \( x \) in \( s \) that is identical to \( x_1 \) and \( x \) went broke in \( s \).

Note—as Schwarz already points out—that this paraphrase is compatible with the presence of a Russelian uniqueness condition (indicated by there exists exactly one as in (2)), since the definite’s descriptive content is restricted to actors that are identical to whatever \( x_1 \)’s interpretation is. But the price of this is that the definite article in (1a) needs to be different from the one in (1b), since there is no way of getting rid of this anaphoric component when it comes to self-standing uses. The first still is interpreted in the sense indicated by (2), while the second really comes down to the paraphrase in (3) (via (4)). Thus, there is one definite article that cannot be used anaphorically, and this version comes with a uniqueness condition, and there is another version that can only be used anaphorically that may or may not contain such a condition, which would be trivialized by the contribution of the anaphoric element.

Summing up, there are two attempts to reconcile the uniqueness implication of self-standing uses of definite descriptions with their anaphoric uses: the first, endorsed most notably by Elbourne, is to restrict the evaluation to minimal situations, so that the anaphorically used definite article can be the same as the self standing one, since the uniqueness condition is trivially satisfied due to the minimality of the situations in play. The second, defended by Schwarz, consists in an ambiguity thesis. Definite articles that are used anaphorically are more complex in that they feature a hidden anaphoric element that helps trivializing the uniqueness condition by revoking the property that has to hold of exactly one individual into an identity claim.

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⁶The individual must be thin in the sense of Kratzer (1989), i.e., stripped of all properties, to avoid unwelcome consequences.
⁷To be precise, the property of being an actor needs to be added to the situations first, thus extending them without adding further individuals. This means that there could be candidate situations that make the first sentence true that do not support this second addition; e.g., situations in which Johnny Depp is no actor. These situations thus are eliminated, the definite’s descriptive content is accommodated.
⁸Schwarz cannot fully avoid using minimal situations due to the way in which he handles quantification. But this does not affect the point made here.
3. File Change Semantics

In Heim’s File Change Semantics (FCS), sentences are evaluated against files, i.e., technically speaking, sets of assignment functions from individual variables to individuals (the so called satisfaction set) together with a domain. The idea is, roughly speaking, that potential antecedents are stored under a variable name in the domain, which is valued by the assignments in the satisfaction set. The satisfaction set thus embodies the information that is associated with these (potential) antecedents. Its shape is regulated by the interpretation process that restricts the range of values according to the lexical material the variables are introduced with. For example, if a sentence like the following is considered, an indefinite description like “a young researcher” opens up such a new ‘address’—say $x_1$—under which every possible individual is stored that is compatible with the information given.

(5) A young researcher blew up his lab after he tried to reproduce the results of an experiment conducted earlier this year by a team that was assembled by his father.

The interpretation procedure has to run through the sentence from left to right. One can think of this as ongoing restriction: first, every individual could be the witness of the indefinite article “a”, which needs to be interpreted first. It just adds a fresh variable to the domain but does not reduce the number of assignments in the satisfaction set since it is compatible with all kinds of continuations. After interpreting its restrictor “young researcher”, this range of values is reduced considerably, by eliminating every assignment that does not value the variable accordingly. Then the information that the value of $x_1$ has to have had a lab (which he then blew up) is added which restricts the range of values even further (and introduces further variables into the domain to store the former lab etc.); and so forth as long as new information is supplied. Generally, the domain of the file can be thought to be empty at the start of a discourse, but then gets filled with more and more variables as soon as sentences like (5) are interpreted. Conversely, the satisfaction set initially consists of the set of all possible assignment functions and starts to shrink while the domain gets filled.9

Heim (1982) famously attempts to cover anaphoric and non-anaphoric uses of definite descriptions with her Extended Novelty-Familiarity-Condition. This is basically achieved by distinguishing two aspects of familiarity (cf. Roberts, 2003, 2004): one that also pertains to personal pronouns, namely the availability of a suitable antecedent, and an entailment requirement to be addressed separately. The first sense of familiarity can be modeled by the domain of the file alone. If one assumes in addition to the linear (left to right) interpretation procedure that there is no other way for a variable to enter the domain apart from being introduced into it by (in)definite descriptions (and proper names), the variables in the domain correspond to all potential (and accessible10) antecedent expressions in the discourse.11 Indefinites have to use a fresh vari-

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9The satisfaction set does not need to shrink because one can introduce variables into the domain that are accompanied by trivialities, e.g., something either is or is not concrete. This adds whatever variable is used to translate something to the domain without excluding any of its possible values.

10There are environments that block the projection of discourse referents, e.g., the complements of negation. Thus, not every suitable expression introduces variables that can be taken up by subsequent anaphoric expressions.

11This assumption ultimately needs to be rejected if one tries to account for deictical uses of personal pronouns and definite descriptions because in this case, there need to be variables in the domain whose values are, e.g., demonstrated objects in the context of utterance. Thus, there needs to be a different way to enter the domain apart from being introduced by one of the expressions mentioned. This can be adapted in the present framework as
able, i.e., a variable that is not part of the domain of the file they are interpreted against. This is the novelty-requirement, which makes it impossible to use indefinite descriptions anaphorically and thus prevents them from erasing information already established. Pronouns, on the other hand, need an antecedent. This means that they have to be translated by a variable that is already part of the domain.\footnote{Or have to be ‘linked’ to one, e.g., introduce a new variable that is claimed to be valued identically to some other variable that was in the domain before. This second way of relating pronouns to their antecedents is the way in which \textit{Discourse Representation Theory} (DRT; Kamp, 1981; Kamp and Reyle, 1993) handles resolution.} This is the first sense of \textit{familiarity}. But since definite descriptions need not to be used anaphorically, Heim proposes a second sense of familiarity, namely the requirement that their descriptive content needs to be entailed by the common ground. This basically means that the values of the variable introduced by self-standing definite descriptions need to be somewhat predetermined (or ‘foreshadowed’) by the satisfaction set of the file. Understood this way, definite descriptions do not introduce something new into the discourse, but just make something explicit that has been assumed (or presupposed) already. To spell this out, Heim relativizes the satisfaction set of files to possible worlds and defines entailment as close as possible to classical possible worlds semantics, namely as a subset relation between two satisfaction sets at the same world. A file $F$ therefore entails a formula $\varphi$ iff it holds for every world $w$ that the satisfaction set $Sat_w(F)$ of $F$ is a subset of the satisfaction set at the very same world that is the result of interpreting $\varphi$ against $F$; i.e., in her notation (Heim, 1982: 236)

\begin{equation}
F \text{ entails } \varphi \text{ iff } Sat_w(F) \subseteq Sat_w(F + \varphi), \text{ for every world } w.
\end{equation}

In other words: a file $F$ entails the truth of a formula $\varphi$ iff it is possible to add $\varphi$ to $F$’s (world dependent) satisfaction set without shrinking it, i.e., loosing a single assignment function.\footnote{From this, entailment between formulas can be derived as follows: one first has to update an unaltered file with all premises, and then show that the resulting file entails the conclusion. If this is the case, then the premises entail the conclusion.}

There are two problems with this account. The first is that it does not seem to be necessary that the content of a self-standing definite description is already entailed by the file; i.e., not every self-standing usage of a definite description merely makes something explicit that was already part of the common ground, as can be seen by the existence of so-called \textit{informative presuppositions}. That is, it is possible to use presuppositional devices consciously in conversations where the common ground clearly does not entail the presupposed material in question. Secondly, in certain environments, the entailment requirement enforces demands on the common ground that are too strong— a puzzle which was coined \textit{Heim’s Problem} (cf. Heim, 1982, 1983; Aloni, 2001; Dekker, 2012). A case in point is the following sentence taken from Heim:

\begin{equation}
\text{(7) A fat man pushes his bicycle.}
\end{equation}

Assuming—just for the sake of argument—that “his bicycle” abbreviates something like “the bicycle he owns”, i.e., a definite description, (7) demands that every fat man in the domain of quantification owns a bicycle. To see this, one needs to go through the sentence from left to right. If the domain of the file is empty, “a fat man” introduces a new variable name—$x_3$ for later reference—and restricts the range of its values to fat men (by eliminating assignments from the satisfaction set that value $x_3$ differently). Then, the verb phrase together with the hidden definite description needs to be interpreted. The pronoun has to be coindexed with the
(contribution of) “a fat man” to derive the intended interpretation. Thus, the definite description spells out as “the bicycle $x_3$ owns”. Given the procedure outlined above, this again inserts a new variable into the domain—say, $x_4$—that is restricted to bicycles owned by fat men. Then the entailment requirement demands that this update does not lose a single assignment function that was present prior to the interpretation of the definite description. But exactly this happens if there exists a fat man in the domain of quantification who does not own a bicycle. If there is an assignment that assigns this man to $x_3$ then there cannot be an extension of it that assigns a bicycle he owns to $x_4$. Hence, this assignment is abandoned, which violates the entailment requirement. Thus, the definite description is predicted to be infelicitous, contrary to fact.

Leaving the entailment requirement aside, this machinery allows for anaphoric relationships even across clause boundaries and thereby captures anaphorically used definite descriptions. But, as it stands, it does not capture the uniqueness effects of self-standing uses, assuming the view of the previous section to be correct. The problem of Heim’s (and similar) system(s) is that the situation variables needed to account for these effects in non-anaphoric uses are alien to the file. Thus, the dilemma in a nutshell seems to be that if definite descriptions are used anaphorically, they need to be evaluated against the file, but if they are used non-anaphorically, they need to be evaluated at some situation (variable) $s$. Thus, in order to not subscribe to an ambiguity thesis again, one needs to reconcile these two parameters of evaluation.

The final step to undertake in this section is the formulation of a version of FCS that is pretty close to the original one as just described, but comes with some simplifications. This version of FCS was mainly laid out in Dekker (1996). He shows that FCS can be understood as a version of Groenendijk and Stokhof’s (1991) Dynamic Predicate Logic (DPL) with partial states and an extension relation in place of the relation of $x$-variants. That is, he incorporates the basic features of FCS into a language that syntactically looks like first order predicate logic. Since the syntax is pretty standard, its definition is omitted here. Dekker’s first simplification consists in using sets of partial assignments instead of total assignments (as Heim does) to form satisfaction sets because, as soon as one assumes their domains to be homogeneous—covering the same variables—the domain of a file can be read off of these sets.\(^{14}\) To establish some notation: $g^X$ is an assignment function with the domain $X$, which is a (finite) set of variables. The superscript is omitted whenever not relevant. A set of variables $X$ is the domain of a partial assignment function $f$ iff it holds for all elements $x$ of $X$ that $f(x)$ is a proper individual while it holds for all $y$ that are not in $X$ that $f(y) = \#$. A file is a set of assignment functions $G$ such that for any two elements of $G$ it holds that their domains coincide. This guarantees that the file consists only of homogeneous assignment functions and their domain can be said to be $G$’s domain as well. The second of Dekker’s amendments consists in using an extension relation as the following, which is well known from DRT’s interpretation mechanism as well:

\[f^X \subseteq V g^Y \text{ iff } Y = X \cup V \& \forall x \in X : g(x) = f(x)\]

That is: an assignment function $g$ (with domain $Y$) extends an assignment function $f$ (with domain $X$) by the set of variables $V$ iff $g$ covers all variables $f$ covers, does not differ from $f$’s

\(^{14}\) Partial assignment functions can be represented by total assignment functions defined over a domain enriched by a ‘dedicated individual’: if $M$ is the domain of individuals, $M \cup \{\#\}$ is the domain “partial” assignment functions are defined over.
assignments on the ‘old’ domain $X$, and additionally also comes up with values for the variables in $V$ (not in $X$). Note that $V$ can be empty, in which case this relation boils down to identity. Note further that $X$ and $V$ are allowed to overlap, but that this does not mean that $g$ can value some variable in $X \cap V$ differently from $f$. This extension relation just is not picky in the sense whether the variables in $V$ need to be ‘fresh’ or not. A relation that only allows for extensions by ‘new’ variables can be obtained from (8) by demanding that $X$ and $V$ do not overlap:

$$(9) \quad f^X \subseteq_v g^Y \iff X \cap V = \emptyset \& f^X \subseteq_v g^Y$$

This stronger relation can be utilized to state Heim’s Extended Novelty-Familiarity-Condition in terms of definedness conditions for formulas. As said above, novelty and familiarity (in the first sense) can be stated with respect to the domain of a file alone if it is guaranteed that there is no way for a variable to enter a file’s domain but by being introduced into it by a suitable expression. If this is the case, then it is enough for a variable to be new with respect to the domain for it to be used for the first time in a discourse. Hence, making the stronger extension relation (9) part of the definedness-conditions of the existential quantifier (10d), which in turn is used to translate indefinite expressions, does the intended job of modeling novelty: if the variable accompanying the existential quantifier—e.g., $x_{23}$—was already in use, the set of extensions of elements of $G$ based on the strong relation—i.e., \{ $h : \exists g \in G : g \subset \{x_{23}\} h$\}—is empty and hence, the whole formula is undefined; as desired.

The other clauses of (10) are as one expects from a dynamic system: atomic formulas are defined as soon as every term is defined; conjunctions are defined iff the successive application of their left and right conjuncts (in that order) is; and negated formulas are defined as soon as their positive counterparts are:

$$(10) \quad FCS: Definedness conditions: \text{An expression } \alpha \text{ is defined for a file } G \text{ iff } [\alpha]^d(G) \neq \emptyset$$

a. $[R \tau_1, \ldots, \tau_n]^d(G) = \{ g \in G : g(\tau_1) \neq \# \& \ldots \& g(\tau_n) \neq \# \}$

b. $[\varphi \land \psi]^d(G) = [\psi]^d([\varphi]^d(G))$

c. $[-\varphi]^d(G) = [\varphi]^d(G)$

d. $[\exists x \in V] \varphi]^d(G) = [\varphi]^d(\{ h : \exists g \in G : g \subset \{x\} h \})$

The truth conditions expressed by the formulas are stated very similarly ($R'$ in (11a) is a constant that represents $R$’s extension):

$$(11) \quad FCS: Truth conditions: \text{A sentence } \varphi \text{ is true wrt. } G \text{ iff } \varphi \text{ is defined for } G \text{ and } [\varphi]^+(G) \neq \emptyset$$

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15Both extension relations are already found in the excellent van den Berg (1996), where several notions of partiality are identified and discussed. The notion of definedness that is relevant here is the one that solely concerns the “bookkeeping device”. That is, in contradistinction to other modes of partiality like presuppositions, there is no need to fully go three-valued, since there should not be a way back from undefinedness to truth or falsity. Undefinedness only arises from violations of the Extended Novelty-Familiarity-Condition, which should not be repairable. Even though van den Berg has both (8) and (9), he does not put them to exactly the same use as it is done here, and neither does Dekker.

16Except for occurrences under negation. But since negation blocks the projection of discourse referents, these occurrences do not matter.

17This is, strictly speaking, not the way Heim sets up FCS in Heim (1982), but the way in which Dekker (1996) modifies DPL to incorporate her basic assumptions.

18There are good reasons to doubt that this is the whole story concerning novelty. (See Muskens, 1996 and especially Krifka, 2001.) Since capturing novelty is not at the center of interest, this discussion is not entered here.
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4. The combination of the two

This section shows how the two kinds of approaches outlined in the previous sections can be combined. What needs to be done is the following: (i) situation variables need to make their appearance in formulas as well as in the domains of files in order to have the notion of uniqueness with respect to a situation available even in a dynamic setting; (ii) a specific kind of update has to be performed by the interpretation of definite descriptions in order to capture their use as self-standing or anaphoric, respectively; and (iii) the uniqueness condition has to apply to its input and its result. Both the update and the uniqueness condition are part of the lexical entry for definite articles, which will be given with the help of a dedicated quantifier prefix “\(D\)

4.1. iFCS

For the purpose of this paper, it is enough to endow the (implicit) syntax of FCS with a single situation variable. Neither Kaplanian two-dimensionality nor attitude ascriptions are tackled here, since the implementation of the means to deal with formulas that depend on more than one situation is rather involved. That means that every sentence will depend on one situational argument in total, which will feature in the translation of predicative material, i.e., (sortal) nouns and verb phrases. It is therefore tacitly assumed that the implicit syntax of FCS above is endowed with a single situation variable—\(s\) for further reference.\(^{19}\) This syntactic change has consequences for files. They cannot start with empty domains anymore because the omnipresent situation variable would not receive a value and thus, no formula could possibly be defined. Hence, the file needs to cover the one situational component from the get-go. In this sense, FCS is intensionalized. In its initial state it covers the situation variable only—collecting all of its possible valuations. Thus, the initial file represents Logical Space (LS), the set of all possible situations. Since further individual variables can be introduced into the domain, assignments generally represent indices, i.e., situations paired with a finite list of individuals; and files represent sets of such indices, i.e., something very similar to standard propositions. This shift in granularity helps in explaining the oscillation of the uniqueness effect.

\(^{19}\)The adaptation of the first order syntax is straightforward. One has to avoid any possible confusion of individual variables—\(x_i\)—with the situation variable, though. That is, there should not be a way to quantify over \(s\) in the present framework, meaning that constructions like \((\exists s)[\varphi]\) should be blocked syntactically. True intensionality (understood as quantification over the situational component) must be implemented differently, in order to leave the “bookkeeping device” untroubled.
With the syntax and the ontology in place, it is now time to give the definitive form of the definedness and truth conditions of intensionalized FCS—iFCS for short:

(12) **iFCS: Definedness conditions**: An expression $\alpha$ is defined for a file $G$ iff $[[\alpha]]^d(G) \neq \emptyset$

a. $[[R_s \tau_1, \ldots, \tau_n]]^d(G) = \{g \in G : g(s) \neq \# \& g(\tau_1) \neq \# \& \ldots \& g(\tau_n) \neq \#\}$

b. $[[\phi \land \psi]]^d(G) = [[\psi]]^d([[[\phi]]^d(G))$

c. $[[\neg \phi]]^d(G) = [[\phi]]^d(G)$

d. $[[\exists x_i] \phi]^d(G) = [[\phi]]^d(\{h : \exists g \in G : g \subseteq \{x_i\} h\})$

(13) **iFCS: Truth conditions**: A sentence $\phi$ is true wrt. $G$ iff $\phi$ is defined for $G$ and $[[\phi]]^+(G) \neq \emptyset$

a. $[[R_s \tau_1, \ldots, \tau_n]]^+(G) = \{g \in G : \langle g(s), g(\tau_1), \ldots, g(\tau_n) \rangle \in R'\}$

b. $[[\phi \land \psi]]^+(G) = [[\psi]]^+(\{[[\phi]]^+(G))$

c. $[[\neg \phi]]^+(G) = \{g \in [[\neg \phi]]^d(G) : [[\phi]]^+(\{g\}) = \emptyset\}$

d. $[[\exists x_i] \phi]^+(G) = [[\phi]]^+(\{h : \exists g \in G : g \subseteq \{x_i\} h\})$

As can be seen, the switch from FCS to iFCS is only reflected in the clause for atomic formulas, where the single situation variable $s$ makes its appearance. In contrast to the extensional fragment before, $R'$ now has to stand for the *intension* of $R$. Apart from that, everything stays the same.

4.2. Definite descriptions in iFCS

A definite description that is evaluated against a file $A$ performs a special kind of update that leads to a (possibly different) file $B$. In this update, two cases are possible: If the individual variable the definite description comes with, $x_i$, is new with respect to $A$’s domain (i.e., has not occurred before so that the definite description is self-standing), it is introduced into it and its values are restricted to those that fulfill the description’s restrictor with respect to the values stored in the assignment. If $x_i$ was used before, the file $A$ is freed from those assignments that store individuals under $x_i$ that do not fulfill the description’s restrictor. Crucially, both cases can be captured simultaneously with the help of the weaker of the two extension relations (8), which is compatible with $x_i$ being new or old. Thus, the first step in the interpretation and the definedness condition are rather similar to those of indefinite descriptions:

(12) e. $[[\exists x_i] \phi]^d(G) = [[\phi]]^d(\{h : \exists g \in G : g \subseteq \{x_i\} h\})$

But the work is not done yet. In a second step, both the input file $A$ and the output file $B$ serve as arguments for the *uniqueness condition* that demands that a special relation holds between the files:

(14) For any sets of assignments $A$, $B$, and individual variables $x_i$: $\text{UNIQUE}_{x_i}(A)(B) = \{h \in B : \exists g \in A \forall V g \subseteq V h \& (\forall h' \in B)[g \subseteq V h' \rightarrow h(x_i) = h'(x_i)]\}$

Informally, this condition checks whether those assignments $h$ in $B$ that are extensions of a single assignment $g$ in $A$ ("$\exists V g \subseteq V h_{n20}$") assign the same individual to $x_i$. If all of them do, they are kept; if they do not, they are eliminated. Even more compressed, the uniqueness

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$20V$ is not restricted to $\{x_i\}$ in order to allow for the introduction of further variables in the scope of $\exists$. Note further that it suffices to pay attention to the difference of the domain of the initial file $X$ and the second one $Y$—i.e., $V = Y \setminus X$. If a $V$ exists that makes the output non-empty, it is this one.
condition demands there to be only one value of the definite’s variable per input assignment in the output. If it is not possible to introduce more than one value for \(x_i\) on the basis of what is found in an element of \(A\), uniqueness holds with respect to this element and hence also with respect to the situation variable’s value stored in it. If the variable occurred before, \(B\) is a subset of \(A\), thus, every element of \(B\) extends exactly one element of \(A\), namely itself. Hence, the uniqueness condition is trivialized in the anaphoric case. Thus, non-anaphorically (attributively) used definite descriptions and anaphorically used ones can be represented by one and the same lexical element, whose truth conditions are thus the following:\(^{21}\)

\[
(13) \quad e. \quad [[(\lambda x_i)[\varphi]]^+(G) = \text{UNIQUE}_{x_i}(G)\left([[\varphi]]^+\left(\{h : \exists g \in G : g \subseteq \{x_i\} \ h\}\right)\right)]
\]

4.3. Examples

Armed with the definitions above, it is time to calculate some examples. The first two will feature self-standing uses of definite descriptions, one where the uniqueness condition is satisfied for all situations in play and one where it is not. Then anaphoric uses are discussed, showing how the very same uniqueness condition is necessarily trivialized in case there is an antecedent in the file’s domain.

4.3.1. Self-standing uses

For illustrative purposes, imagine four situations \(s_1–s_4\) such that there exists only one man in each of them, namely \(a\) in \(s_1\) and \(s_2\), \(b\) in \(s_3\) and \(c\) in \(s_4\). Thus, when a definite description like the man (parsed as (15)) is interpreted against any of those situations, the uniqueness condition should be satisfied because there exists only one man per situation.

\[
(15) \quad (\lambda x_1)[M_s x_1]
\]

To show that this prediction is borne out, consider what the described update procedure does to the initial state of a file \(G\) (cf. (16a)), just consisting of all possible values for the one situation variable \(s\): since \(x_1\) is new with respect to \(G\), it is simply added to the domain and it is assigned every possible individual as value. Then, the descriptive part of the definite description eliminates all non-men from the so created intermediate file, yielding the file \(H\) in (16b)—(16b) is thus the result of calculating \([M_s x_1]^+\left(\{h : \exists g \in G : g \subseteq \{x_1\} \ h\}\right)\). Because of the situations being as described, this procedure cannot produce any other output. Then, the uniqueness condition in (14) comes into play. It checks whether it holds for any input assignment in \(G\) (its first argument) that gets extended in \(H\) (its second argument) that there is no further extension in \(H\) that hosts a different individual in the \(x_1\)-slot. There are other assignments, but they extend different input assignment and thus do not interfere. Hence, the uniqueness condition yields \(H\) as a final result (given that nothing of interest happens in the omitted part).

\(^{21}\)The uniqueness condition is not part of the definedness conditions for definite description due to what is said in fn. 15: the notion of partiality that is modeled here is not that of presuppositions (or presupposition failures), but of the “bookkeeping device”. If one wants to talk about presuppositions, further definedness conditions (on top of (12)) have to be introduced. The interested reader is once again referred to van den Berg (1996).
This is different in case there is another situation, $s_5$ in which more than one man (namely $c$ and $d$) exists. This situation then also is part of the initial state $G'$ (cf. (17a)). This time, the assignment assigning $s_5$ to $s$ gets extended by two assignment functions in $H'$—i.e., $\left[M_{s_5}\right]^{+}\left(\{h : \exists g \in G' : g \subseteq_{\{x_1\}} h\}\right)$—, namely $h'_{5,1}$ and $h'_{5,2}$, because the definite’s restrictor fails to eliminate either of those two (possible) values of $x_1$. In this configuration, the uniqueness condition (14) eliminates both assignments from $H'$ (which it takes as second argument next to $G'$), yielding $H''$, because it only collects those assignments from $H'$ that behave as desired. Thus, every descendant from the initial assignment $g_5$ that assigns $s_5$ to $s$ is trashed in the process. The non uniqueness-supporting situations are thus removed from the file.\footnote{This corresponds to the accommodation-step in Heim’s system.}

4.3.2. Anaphoric uses

A definite description is used anaphorically if the variable it comes with was used in interpreting some expression uttered the discourse before. Then, the variable is in the domain of the file the definite description is interpreted against. The introducing expression might have been a different definite description, namely one of those discussed in the preceding subsection, or any other expression that is endowed with the capability to introduce discourse referents, e.g., indefinite descriptions, proper names, and the like. In this case, the anaphorically used definite description does not introduce a fresh variable into the domain, but simply elaborates on the values that are stored in the file. Thus, there are just two cases to consider: either (i), all the values stored under the variable name in the input file fulfill the descriptive content expressed by the restrictor, then the update does not alter the file at all, or (ii) some of the values (or even all) do not pass this test, then the respective assignments are eliminated; the definite’s descriptive content is accommodated again. Thus, the outcome of the first interpretation step either is an unaltered input file (i) or a subset thereof (ii). The uniqueness condition (14) thus is either fed, e.g., $G''$ (cf. (18a)) twice, or $G''$ as first and $H'''$ (cf. (18b)) as second argument:

\begin{tabular}{|c|c|c|}
\hline
$G$ & $s$ & $x_1$ \\
\hline
$g_1$ & $s_1$ & # \\
$g_2$ & $s_2$ & # \\
$g_3$ & $s_3$ & # \\
$g_4$ & $s_4$ & # \\
$g_5$ & $s_5$ & # \\
\hline
\end{tabular} \hspace{1cm}
\begin{tabular}{|c|c|c|}
\hline
$H$ & $s$ & $x_1$ \\
\hline
$h_1$ & $s_1$ & a \\
h_2 & $s_2$ & a \\
h_3 & $s_3$ & b \\
h_4 & $s_4$ & c \\
\hline
\end{tabular}
In both cases, the uniqueness condition returns its second argument without any changes for trivial reasons. In the first case because every assignment in $G''$ extends itself and only itself (focusing attention on $V = \emptyset$), and thus, there is no different second assignment in $G''$ per input assignment in $G''$ that could differ in the value for $x_1$; in the second case because the remaining assignments in $H'''$ also extend themselves (in $G''$), while the other assignments in $G''$ do not matter at all. This is because the uniqueness condition (14) reads “if there is an assignment in the second argument ($H'''$) that extends an assignment in the input ($G''$), then there is no further assignment that does the same while differing in the value for $x_1$.” Thus, since no extension of the domain of the assignments takes place, the uniqueness condition holds trivially, without implying uniqueness of the value of $x_1$ (with respect to the property expressed by the restrictor) in the situation that is the value of $s$, as is witnessed by $g''_4$ and $g''_5$ in $G''$ and $H'''$.

### 4.3.3. More involved cases

The two basic cases just discussed are not affected by more structure in the initial files. That is, it does not change anything substantial if the variable introduced by the definite description is not the first individual variable in the domain of the file. If a file like $J$ is considered that might be thought of as arising from interpreting a (sequence of) sentence(s) containing an indefinite description that made use of $x_2$, a definite description like (15) still can introduce $x_1$ together with all possible values and reduce them to men in the situations stored in the assignments under $s$. The result of this cannot be a file like $J'$ that would wrongly pass the uniqueness condition (14) unaltered because $J'$ does not contain all assignments compatible with the facts. If the situation $s_1$ indeed hosts three men $d$, $e$, and $f$, then it is not enough to extend the first assignment in $J$ by only one assignment as it is done in $J'$. Instead, $j_1$ in $J$ alone has to have three extensions, namely $j''_{1,1} - j''_{1,3}$ as in $J''$. The same then holds for $j_2$ and $j_3$ in $J$. These assignments too have to have three extensions, as depicted in $J''$, covering all the men in $s_1$. 

<table>
<thead>
<tr>
<th>$G''$</th>
<th>$s$</th>
<th>$x_1$</th>
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<tbody>
<tr>
<td>$g''_1$</td>
<td>$s_1$</td>
<td>$a$</td>
</tr>
<tr>
<td>$g''_2$</td>
<td>$s_2$</td>
<td>$b$</td>
</tr>
<tr>
<td>$g''_3$</td>
<td>$s_3$</td>
<td>$a$</td>
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<tr>
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<td>$a$</td>
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<tr>
<td>$g''_5$</td>
<td>$s_4$</td>
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<table>
<thead>
<tr>
<th>$H'''$</th>
<th>$s$</th>
<th>$x_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$g'''_3$</td>
<td>$s_3$</td>
<td>$a$</td>
</tr>
<tr>
<td>$g'''_4$</td>
<td>$s_4$</td>
<td>$a$</td>
</tr>
<tr>
<td>$g'''_5$</td>
<td>$s_4$</td>
<td>$b$</td>
</tr>
</tbody>
</table>

\[(18)\]
If \( J \) and \( J'' \) are handed over to the uniqueness condition (14) as first and second argument, respectively, all assignments hosting \( s_1 \) as the value of \( s \) are eliminated. There simply is no single man with respect to \( s_1 \), thus, this is the desired outcome.

The presence of additional individual variables in the file’s domain allows the definite description to introduce its variable based on more parameters than just the situation variable \( s \). If, e.g., (20b) is taken to be the translation of the definite description together with the restrictive relative clause in (20a), whereas \( x_1 \) is the translation of the pronoun, then the additional discourse referent matters.

(20)  
a. A girl ate the chewing gum she bought.

b. \((\{x_2\}|Cs_{x_2} \land Bs_{x_2}x_1)\)

(21)  
a.  

\[
\begin{array}{ccc}
J & s & x_1 & x_2 \\
\hline
j_1 & s_1 & a & \# \\
j_2 & s_1 & b & \# \\
j_3 & s_1 & c & \# \\
j_4 & s_2 & a & \# \\
j_5 & s_2 & c & \# \\
\end{array}
\]

b.  

\[
\begin{array}{ccc}
J' & s & x_1 & x_2 \\
\hline
j_{1}' & s_1 & a & c_1 \\
j_{2}' & s_1 & b & c_2 \\
j_{3}' & s_2 & a & c_1 \\
j_{3}' & s_2 & b & c_2 \\
j_{4}' & s_2 & b & c_3 \\
\end{array}
\]

In contrast to a sentence like a girl ate the chewing gum that—assuming that the definite description is used non-anaphorically—would force the uniqueness condition (14) to eliminate all assignments assigning a situation with more than one chewing gum to \( s \)—in the case at hand, all assignments featuring \( s_1 \) or \( s_2 \)—(20a) allows for a more fine-grained elimination. This is due to the relative clause, i.e., the relativization of chewing gums to those bought by the value of \( x_1 \). Thus, a definite description like (20b) interpreted against a file like (21a) yields (21b). The uniqueness condition then eliminates those assignments that assign more than one value to \( x_2 \) per input assignment in \( J \), namely \( j_{3}'_1 \) and \( j_{3}'_2 \). Thus, it excludes girls that bought more than one chewing gum. The final outcome is (21c):
As can be seen, even though there is a girl in $s_2$ that bought more than one chewing gum—namely $a$—, $s_2$ as a possible value of $s$ is not eliminated from the file altogether. Only those assignments featuring $a$ and $s_2$ (as values of $x_1$ and $s$) are cut in the process; $j_4'$ remains to be a candidate because $b$ only bought one chewing gum. That assignments featuring $s_2$ pass the test the uniqueness condition poses means that this account does not suffer from Heim’s Problem.

Cases of bridging can be understood along the same lines as this last example as well. If the second sentence of (22) is parsed as indicated in (22a), i.e., with a hidden anaphoric element in *steering wheel*, then the definite description emerging from this parse is as in (22b). Thus, once again, the value of $x_3$, the variable newly introduced by the definite article, depends on more than just the situational parameter, namely the hidden anaphoric $x_2$, relating back to the car introduced in the first sentence. The steering wheel introduced on this basis then is unique with respect to a car in the situation without needing to be unique with respect to the situation simpliciter.

(22)  
Peter has a new car. The steering wheel is yellow.
\[\text{a. Peter}^{x_1} \text{ has a}^{x_2} \text{ new car. The}^{x_3} \text{ steering wheel of it}^{x_4} \text{ is yellow.} \]
\[\text{b. } \ldots (\Box x_3)[S_{x_2}x_1] \land Ysx_3 \]

Furthermore, for completeness’ sake, the lexical entries introduced can also deal with complex restrictors as in (23)

(23)  
\[\text{a. The}^{x_1} \text{ man with a}^{x_2} \text{ cat } \ldots (\Box x_3)[M_{x_1} \land (\exists x_2)[Cx_{x_2}] \land W_{x_2}x_1] \]
\[\text{b. The}^{x_1} \text{ man with the}^{x_2} \text{ cat } \ldots (\Box x_1)[M_{x_1} \land (\Box x_2)[Cx_{x_2}] \land W_{x_2}x_1] \]

Neither the presence of the second definite description in (23b) nor the indefinite article in (23a) change anything substantial. This is due to the selective nature of the uniqueness condition (14). Suppose again that the whole definite description in (23a) is interpreted against a rather sparse file like $K$ and that the update that provides the second argument for the uniqueness condition yields $K'$:

\[
\begin{array}{|c|c|c|c|c|} \hline
K & s & x_1 & \ldots & K' & s & x_1 & x_2 & \ldots \\
\hline
k_1 & s_1 & \# & \ldots & k'_{1,1} & s_1 & m_1 & c_1 & \ldots \\
k_2 & s_2 & \# & \ldots & k'_{1,2} & s_1 & m_2 & c_2 & \ldots \\
k_3 & s_3 & \# & \ldots & k'_{2} & s_2 & m_3 & c_3 & \ldots \\
\ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\
\hline
\end{array}
\]

\[
\begin{array}{|c|c|c|c|c|} \hline
K'' & s & x_1 & x_2 & \ldots & K'' & s & x_1 & x_2 & \ldots \\
\hline
k'_{3,1} & s_3 & m_1 & c_1 & \ldots & k'_{3,1} & s_3 & m_1 & c_1 & \ldots \\
k'_{3,2} & s_3 & m_1 & c_2 & \ldots & k'_{3,2} & s_3 & m_1 & c_2 & \ldots \\
\ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\
\hline
\end{array}
\]

If the uniqueness condition applies to $K$ and $K'$, it rightly eliminates all extensions of $k_1$, namely $k'_{1,1}$ and $k'_{1,2}$, simply because the update procedure had no choice but to introduce more than one value for $x_1$. But, as depicted in $K''$, extensions of $k_3$ survive this procedure because there is only one man in the column for $x_1$. The presence of more that one cat in the next column—or, more generally, branching paths—does not interfere with the workings of the uniqueness
condition (14) because it is only interested in the number of values $x_1$ is assigned. That is why it can be called selective.

$K''$ also depicts an intermediate stage in the interpretation of the example with two nested definite descriptions (23b). It is not the argument of the uniqueness condition of the outermost definite article, though, but arises before the uniqueness condition of the inner definite is calculated. This step eliminates extensions of $k_3$ because cat is not relativized to anything apart from the situation variable. Thus, if there is more than one cat in a situation with only one man, the respective assignments get eliminated. The extensions of $k_1$ are not affected by this step, but get eliminated by the outer definite's uniqueness condition, as before. Hence, the only element of $K''$ that makes it is $k_{12}$.23

Note finally that the present system is able to deal with classical counterexamples to situation-based accounts of uniqueness effects, namely (variants of) sage-plant examples and bishop sentences (cf. Heim, 1990):

(25) a. If someone buys a sage plant, she buys eight other along with the sage plant.
   b. If a bishops meets a bishop, the bishops blesses the bishop.

The definite descriptions in (25) would all violate uniqueness with respect to the situation if they were used non-anaphorically. This holds true even in situation-theoretical systems where the ‘size’ of the situation is strictly regulated by the interpretation of the preceding material. That is, every ‘minimal’ situation that makes the antecedent of the conditional in (25b) true needs to contain at least two bishops so that there is no way in which the definite description can be felicitous. Roughly the same holds for (25a) as well, where it would be wrong to paraphrase the contribution of the definite description as the sage plant she bought, if this paraphrase is meant to feature a self-standing definite description. Since there is no situational part where the person in question buys a single sage plant—at least, its not immediately obvious that buying nine sage plants can always be analyzed into nine individual buying events, featuring only a single sage plant each—the situation-theoretical approach to anaphoricity runs into a problem. Admittedly, this kind of parse does not make it in the present system as well (it renders the sentence self-defeating), but there is a simple alternative: instead of introducing a new variable, the definite description can reuse the one introduced by the indefinite “a sage plant”. This carries over to (25b) as well: assuming that both indefinite descriptions “a bishop” each introduce their own variable (which they do according to the lexical rules in (12) and (13)), the following definite descriptions can each reuse one of them. Furthermore, using “a sage plant” in (25a) is compatible with buying more than one; and anaphorically relating back to the indefinite with a definite description does not change that.

That the sentences feel unnatural to some degree might be due to two factors. Both readings could be expressed by using personal pronouns instead of full definite descriptions and hence, by using ‘lighter’ lexical material. Furthermore, the symmetry of the configuration in (25b) may contribute to the oddness in the following sense: it cannot be determined whether the first definite anaphorically relates back to the first indefinite or to the second; and likewise for the

23Thus, the system at hand does not solve what is known as Haddock’s Puzzle (Haddock, 1987) automatically, even though it should not be too difficult to make it compatible with existing solutions from the literature (e.g. Champollion and Sauerland, 2011; Bumford, 2017).
second one. Thus, the use of definite descriptions in examples like (25) may trigger some sort of Gricean implicature, since the anaphoric devices *par excellence*, i.e., personal pronouns, are avoided, which then stands in conflict to the observed impossibility of a self-standing use. This might also be the source for the following intuition (cf. Roberts, 2003: (40), p. 324):

(26) A woman entered from stage left. Another woman entered from stage right.

#The woman ✓ The FIRST woman ✓ The SECOND woman was carrying a basket of flowers.

The present systems allows for two parses that would render the use of the definite description felicitous. It could either reuse the variable contributed by the first (“a woman”) or by the second indefinite description (“another woman”). What makes the choice for “the woman” worse than the alternatives mentioned by Roberts seems to be exactly the same kind of indeterminacy as above, since (i) both possible antecedents fit in descriptive content, and (ii) the anaphorically used definite would not express something that could not be expressed by a simple “she” as well. Thus, even though the sentence has a parse that would make it fine semantically, it might be ruled out for pragmatic reasons.

5. Conclusions and prospects

The present article has shown how a unified analysis of definite descriptions can be provided in a framework like FCS endowed with situation variables. It has not argued that this is the only analysis possible. As mentioned, Schwarz (2009) makes the case for an ambiguity between an anaphoric and a self-standing use based on languages that make morphological distinctions along these lines. A case in point may be the subtle difference in the following two forms of standard German:

(27) Ich war im / in dem Supermarkt.

I was in-the weak / in the strong supermarket.

The full-fledged, strong form of the definite article seems to be felicitous only in case it is used to refer back to a supermarket that is mentioned before; hence, if the definite is used anaphorically. If the definite is used without antecedent, and hence uniqueness entailing, it must be in its reduced, weak form. The present analysis does not challenge this assessment. It complements it with a smooth alternative for languages where reasons for assuming an underlying

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24 What can be ruled out on the basis of classical binding theory is that both pick the same antecedent (or that the second definite anaphorically relates back to the first), since this would violate principle C. How binding theory is implemented in a dynamic framework is a different question, though. There are several remarks on this in Kamp and Reyle (1993), which are more thoroughly discussed in Berman and Hestvik (1994).

25 Which pose their own problems since “first” and “second” (like “former” and “latter” and similar to “aforementioned”) seem to refer to the order in which the women are mentioned and hence to a property of expressions rather than referents.

26 Roberts claims that “she” instead of “the woman” unambiguously refers back to the second indefinite “another woman”. If this is the case, there is a contrast between using personal pronouns and anaphoric definities whose descriptive content is matched by more than one antecedent. But then, one would expect an implicature to the end that the definite unambiguously refers back to the first indefinite description. Something like this has been claimed for d-pronouns in German (cf. Bosch et al., 2003), but the semantics for these pronouns seem to be more complicated (cf. Hinterwimmer, 2015).

27 Ignoring deictical uses for the moment.
ambiguity cannot be provided as easily. If one wishes to do so, one can implement the two articles Schwarz proposes into the present system as well (recall that the uniqueness condition in (28b-ii)) runs idle and can safely be omitted:

(28) a. (i) \[ \llbracket ([\text{weak}_{x_i}] \varphi) \rrbracket^d(G) = \llbracket \varphi \rrbracket^d(\{h : \exists g \in G : g \subset \{x_i\} h\}) \]
(ii) \[ \llbracket ([\text{weak}_{x_i}] \varphi) \rrbracket^+(G) = \text{UNIQUE}_{x_i}(G)(\llbracket \varphi \rrbracket^+(\{h : \exists g \in G : g \subset \{x_i\} h\})) \]

b. (i) \[ \llbracket ([\text{strong}_{x_i}] \varphi) \rrbracket^d(G) = \llbracket \varphi \rrbracket^d(\{g \in G : g(x_i) \neq \#\}) \]
(ii) \[ \llbracket ([\text{strong}_{x_i}] \varphi) \rrbracket^+(G) = \text{UNIQUE}_{x_i}(G)(\llbracket \varphi \rrbracket^+(G)) \]

The next steps are rather obvious: iFCS needs to gain the capacity to deal with more than one situation variable at the same time in order to account for intensional environments proper and to implement Kaplanian two-dimensionalism in order to account for deictical/referential uses of pronouns and definite descriptions. The “bookkeeping” device is severely complicated by multi-modalism partly because the presence of further situation variables seems to come with a whole new set of constraints (cf. Percus, 2000). Also, the meta-theoretical interpretation of assignment functions as representing indices demands that they are limited to one situational component; hence, multi-modal formulas depend on more than one file. Finally, the representation of contexts seems to be even more restricted so that further constraints are called for.\(^{28}\)

References


\(^{28}\)The interested reader is referred to Köpping (2018), where I covered most of the topics just mentioned.


Reverse Sobel Sequences and the Dissimilarity of Antecedent Worlds\footnote{We would like to thank Prof. Dr. Maribel Romero and Prof. Dr. María Biezma for their invaluable input and support. We also wish to thank Mark-Matthias Zymla, Erlinde Meertens, and Felix Frühauf for their comments and discussion. We would furthermore like to thank the attendees of Sinn und Bedeutung 24 for their constructive feedback and discussion. Last but not least, we would like to thank all native speakers that kindly provided me with their intuitions regarding reverse Sobel sequences. This research has been supported by the Research Unit 1614 “What if?”, funded by the Deutsche Forschungsgemeinschaft (DFG) under RO 4247/1-2.}

David KRASSNIG — University of Konstanz

**Abstract.** We have conducted an acceptability judgement experiment to examine two hypotheses related to the felicity of reverse Sobel sequences (rSS). The first hypothesis was based upon Lewis’ (2018) relevance-based variably-strict semantics: If two rSS are identical except for their respective difference in dissimilarity between their antecedent worlds, then the rSS with a higher degree of dissimilarity should be, on average, more acceptable. Our results, however, seem to support this hypothesis only weakly and appear more contradictory than supportive to the model behind it: Any kind of clear-cut dissimilarity will render an rSS felicitous, so long as its conditionals are counterfactual by nature. The second hypothesis, that rSS whose domains of quantification are entirely disjoint should be just as acceptable as regular utterances, was quasi-confirmed. Whilst a significant difference to the control items was found, these rSS differ only minimally in average acceptability and are the highest rated rSS so far. We therefore explain the slight, statistically significant decrease in acceptability as a result of the markedness of rSS structures. Finally, we provide two analyses to account for the data gathered. First, one modification of Lewis’ (2018) account, where we argue that relevance may not increase closeness beyond the levels set forth by worlds similarity. Then, with the second account, we attempt to motivate the need for and the pragmatic contribution of contrastive stress with regards to rSS, using Ebert et al.’s (2008) assumption that antecedents represent their conditional’s aboutness topic – thereby deriving contrastive topic with regard to the two sets of antecedent worlds.

**Keywords:** reverse Sobel sequences, relevance, contrastive stress, conditionals, variably-strict semantics, world closeness, contrastive topic, aboutness topic, counterfactuality

1. **Introduction**

A Sobel sequence (hereafter SS) is a sequence of conditionals whose underlying semantic structure adheres to the pattern “If $\varphi$ then $\chi$, but if $\varphi$ and $\psi$ then not $\chi$”, as seen in (1). They, and their reversals, commonly referred to as reverse Sobel sequences (hereafter rSS), as seen in (2), have played and continue to play a key role in the discussion on how to model conditionals.

\begin{quote}
(1) If the USA threw its weapons into the sea tomorrow, there’d be war; but if all the nuclear powers threw their weapons into the sea tomorrow, there’d be peace.
\hspace{1cm} \textit{(Lewis, 1973)}
\end{quote}

\begin{quote}
(2) If all the nuclear powers threw their weapons into the sea tomorrow, there’d be peace; # but if the USA threw its weapons into the sea tomorrow, there’d be war. \hspace{1cm} \textit{(Heim, 1994)}
\end{quote}

There are two main lines of thought to the current debate: Variably-strict (Stalnaker, 1968; Lewis, 1973) and dynamic strict analyses (von Fintel, 2001; Gillies, 2007). The former predict SS to be universally felicitous, which runs counter to Heim’s infelicitous example, provided in
The dynamic strict accounts, on the other hand, predict, by design, all rSS to be infelicitous. However, as Moss (2012) pointed out, not all rSS are inherently infelicitous:

(3) If kangaroos had no tails and they used crutches, they would not topple over. But if kangaroos had no tails, they would topple over.  
(adapted from Lewis (1973: p. 1.9) by Lewis (2018: p. 487))

(4) (Holding up a dry match, with no water around) If I had struck this match and it had been soaked, it would not have lit. But if I had struck this match, it would have lit.  
(adapted from Stalnaker (1968: p. 106) by Lewis (2018: p. 487))

(5) (Said to someone who had just been completely alone by a frozen lake) If you had walked on the thin ice while being supported by someone on the shore, the ice wouldn’t have broken. But, of course, if you had walked on the thin ice, the ice would have broken.  
(adapted from Bennett (2003: p. 166) by Lewis (2018: p. 488))

This would render the variably-strict accounts too lenient and the dynamic strict accounts too strict. As such, a recent trend in semantics and pragmatics has been to take the more lenient variably-strict semantics and combine them with additional exclusionary mechanisms that render specific rSS either infelicitous or inconsistent (Moss, 2012; Klecha, 2015; Lewis, 2018).

In one such case, Klecha (2014, 2015) argued that there are actually two types of SS: True SS (where \( \phi \) and \( \psi \) in the antecedent are causally unrelated) and Lewis sequences (where the antecedent’s propositions are causally related). He argues that only reverse Lewis sequences are universally infelicitous and provides an imprecision-based explanation for their unidirectionality. True Sobel sequences, on the other hand, are unequivocal (i.e. they are “a single pointful piece of discourse”, as stated by Edgington (1995)) and, in principle, reversible. As such, we mostly concern ourselves with reverse True Sobel sequences for the remainder of this paper.

In another one such recent innovation, Lewis (2018) sought to explain the infelicity of rSS by turning the world-ordering for conditionals into a dynamic process: She argues that world closeness is determined by a function of both similarity and relevance (Lewis, 2018), rather than purely by similarity as previously believed (e.g. Lewis, 1973). In her framework, further elucidated in § 1.1, the possible infelicity of rSS comes down to (i) the perceived relevance of the \( \phi \land \psi \)-worlds and (ii) the degree of dissimilarity between \( \phi \land \psi \)-worlds and \( \phi \)-worlds.

This paper has two main goals: First, to empirically test Lewis’ (2018) prediction that rSS with similar antecedent worlds are less likely to be felicitous than rSS with dissimilar antecedent worlds. Second, to empirically test whether rSS are considered felicitous if their sets of worlds belong to different domains of quantification (live possibility worlds vs counterfactual worlds), to see the acceptability of the most likely felicitous type of rSS under both schools of thought.

This paper is structured as follows: In § 1.1, we give a summary of Lewis (2018). In § 2, we go through the materials and method for the conducted experiment. In § 3, we relay the experiment’s results. Then, in § 4, we interpret and discuss the results shown in the previous section and how they relate to the first goal / hypothesis in § 4.1 and the second goal / hypothesis in § 4.2. We enhance the collected data with additional introspective observations in § 4.3 and sketch out two mutually compatible accounts for the gathered findings in § 4.4.1 and § 4.4.2. Finally, in § 5, we provide our conclusion and give thoughts for future research.
Lewis (2018) argues that the effect of the first conditional on the context is pragmatic by nature, as hypothesised by Moss (2012), but also that this pragmatic effect has a semantic influence on the interpretation of the second conditional, as assumed by von Fintel (2001) and Gillies (2007). In her account, first proposed to solve the problem of counterfactual skepticism² (Lewis, 2016), said pragmatic effect affects the world closeness ordering post-utterance and, as such, has a possible effect on the semantic evaluation of subsequent conditionals. This is done by turning closeness into a function of similarity and world relevance:

(6) For all contexts $c$, $\phi \Box \rightarrow \psi$ is true at $w$ in $c$ iff all the closest $\phi$-worlds to $w$ are $\psi$-worlds, where closeness is a function of both similarity and relevance.

(adapted from Lewis, 2016: p. 292)

In her system, similarity provides the basic layout for the world closeness ordering. This layout is then modified by the differing values of relevance we ascribe to each possible world. If a world is ascribed high relevance, it is moved correspondingly closer to the evaluation world. If the world in question is ascribed substandard levels of relevance, on the other hand, it is pushed further away from it. As such, even though possible worlds have similarity-based anchors in the world ordering, there is a certain degree of bidirectional mobility given to any possible world.

The relevance of worlds is mostly manipulated by conversational context and discourse. Discourse participants can thus actively, but limitedly, shape the world ordering: “They can indirectly affect what is (ir)relevant by changing the conversational purposes, by, for example, raising the standards of precision, making something salient, raising a new question under discussion, or refusing to accommodate a shift in conversational purpose.” (Lewis, 2018: p. 500).

Regarding this, the raising to salience is of special import to rSS: Since discourse participants must take the antecedent of a conditional seriously,³ in order to evaluate the counterfactual, the possibility of the antecedent is thereby automatically raised to salience (Lewis, 2018). This, in turn, may raise the relevance of the antecedent worlds and thereby their place in the world ordering. Concerning infelicitous rSS, such as the one in (2), this equates to the $\phi \land \psi$-worlds being pushed towards the evaluation world such that they are counted amongst the closest $\phi$-worlds, rendering the utterance of the subsequent $\phi$-conditional into a contradiction:

![Figure 1: World ordering and selection for infelicitous rSS according to Lewis (2018).](image)

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²This refers to the worry that nearly all would-counterfactuals (that we take to be true) are false. We refer to Lewis (2016) for details due to reasons of space and a lack of direct relevance to the topic at hand.

³As Lewis (2018: p. 500) notes, this is done in various ways: e.g. by existence presuppositions (von Fintel, 2001), entertainability presuppositions (Gillies, 2007), or the pragmatic raising to salience of its possibility (Moss, 2012).
However, if the $\phi \land \psi$-worlds of the first conditional are too dissimilar to the $\phi$-worlds of the second conditional, then the former are not move close enough to count amongst the latter. In (5), for example, it was specified that the person in question was very much alone by the frozen lake. When talking about whether or not that person would have broken through the ice, had they walked upon it, the possibility of a person spontaneously appearing as if out of thin air is simply not relevant enough to most discourse participants. As such, no relevance-induced world shifting takes place in (5) or in any of the other felicitous rSS. As such, the $\phi$-conditional does not quantify over $\phi \land \psi$-worlds, leading to a consistent sequence of conditionals.

![World orderings and selections of consistent rSS according to Lewis (2018).](image)

Note that Lewis (2018) does not promote some specific measure by which to tell when two sets of worlds are far enough apart from one another, as this may vary from person to person or context to context. The instability concerning the felicity judgments of rSS is therefore also predicted by this account, as its sensitivity to discourse relevance grants the discourse participants some leeway in their semantic evaluation of the conditionals: “Hearing things at one moment as felicitious (consistent) and the next as infelicitous (inconsistent), or vice versa, is an expected feature of a phenomenon involving context sensitivity.” (Lewis, 2018: p. 502)

As an added side-benefit, using Lewis’ (2018) analysis, Klecha’s (2015) observations regarding Lewis sequences and True SS can neatly be accounted for under a single phenomenon, rather than having to consider them as separate phenomena with a coincidentally equal surface structure with two separate explanations. For more details on this, we refer to Krassnig (2017).

### 2. Material & Methods

To accomplish our two goals, testing Lewis’ hypothesis concerning the effect of world similarity on infelicity and testing whether or not disjoint antecedent worlds rSS are as acceptable as regular sentences, we have formulated two hypotheses which shaped our experiment’s design:

1. If two rSS are the same except for the degree of similarity between their conditionals’ antecedent worlds, then the rSS whose degree of similarity is more disparate should be considered more acceptable on average.

   (hereafter the **dissimilar worlds hypothesis**)

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4One could also argue that some relevance-induced restructuring does take place, but that its effects are not felt, because the $\phi \land \psi$ worlds have fallen short of the intended target. As this would make no difference to never having moved at all, at least to the cases within this paper, we ignore this possibility for sake of simplicity.
2. If the domains of quantification of an rSS are entirely disjoint, there should be no difference in acceptability between them and regular sentences (i.e. the control items).

(hereafter the disjoint domain hypothesis)

This section is structured as follows: In § 2.1, we explain how we designed the materials that made up our experiment. Then, in § 2.2, we explicate the method used for our experiment.

2.1. Materials

In order to test the dissimilar worlds hypothesis, we created five experimental items which contain an rSS each and were presented with two different contexts: Differing as little as possible, they either indicate that the $\phi \land \psi$-worlds and $\phi$-worlds are very similar to one another or very dissimilar to one another. These respectively represent the SIMILAR and DISSIMILAR conditions. From a syntactic point of view, all conditionals are future-less-vivids and, deviating from the classical examples, contain the auxiliary verb *did* in front of the $\phi$-antecedent’s main verb. The auxiliary verb was inserted in order to ensure that the $\phi$-conditional’s antecedent is not a syntactic subset of the $\phi \land \psi$-conditional’s antecedent. This was necessary, since Klecha (2015: p. 135) posited that the $\phi$-antecedent being a syntactic subset of the previous conditional’s antecedent would automatically render the rSS infelicitous, as some form of contrastive stress in the second conditional is required. The attentive reader may have noticed that we already encountered a counterexample to this restriction in (4). However, preliminary testing with native speakers of English prior to the experiment has shown (i) that the auxiliary verb *had* appears obligatorily stressed in this rSS, even though it occurs in either sequence conditional, and that (ii) this rSS is rendered less acceptable by turning it into the future-less-vivid conditional in (7). Introducing either *did* or *were to* then improved the acceptability for the same native speakers of English. We then decided on using *did* for the sake of simplicity. For more on this, we refer to § 4.3, where we further explore our intuitions regarding contrastive stress.5

(7) *(Holding up a dry match, with no water around)* If I struck this match and it was soaked, it would not light. ? But if I struck this match, it would light.

In total, this led us to the experimental pattern in (8), which, in turn, led us to our experimental items, as seen in (9). The remainder of the experimental target items may be found here: http://bit.ly/2OyZgSN

(8) Context text common to either condition

(i) Context text that sets the $\phi \land \psi$-worlds and $\phi$-worlds as similar to one another.

(ii) Context text that sets the $\phi \land \psi$-worlds and $\phi$-worlds as dissimilar to one another.

S: If $\phi \land \psi$, (then) $\neg \chi$; but if did-$\phi$, (then) $\chi$.

(9) Andy’s friend Michael plans to go to a cabin in the woods during the semester break. He is not convinced, however, that it will be a fun trip, because he is terrified of storms and he would have no way out if one took place.

(i) His trip would be during an average month of the year and Andy thinks that a storm would be possible but not too likely.

5Please note that, from here on out, we refer to intuitions gathered from native speakers of English as our intuitions for the sake of simplicity and brevity. Whilst we share most of these intuitions, being a non-native speaker of English, we have either confirmed or first learned of these intuitions by asking native speakers of English.
(ii) His trip would be during the driest month of the year and Andy thinks that a storm would be impossible or at the very least extremely unlikely.

A: If you went to the cabin and a storm came, your trip would be horrible; but if you did go to the cabin, it would be a pretty good trip.

In order to test the disjoint domain hypothesis, we furthermore created five experimental items that also contain an rSS each, but which were presented with only one context. These represent the DISJOINT condition. Aside from the context, and a subsequent sentence explicating the purpose of the rSS, these items are identical in shape to the previously shown experimental items. However, there is one difference which pertains to the hypothesis tested: Whilst the $\phi$-conditionals remains a standard future-less-vivid conditional, the $\phi \land \psi$ conditional is counterfactual by nature, though it retains the same overt tense structure as the other conditionals. This shift from counterfactual to live possibilities is motivated by the fact that both variably-strict and dynamic strict conditional models would generally assume that conditionals about live possibilities would not take counterfactual worlds into account. As such, either approach should predict felicity. See below for an example item. The remaining experimental target items may be found here: http://bit.ly/2OyZgSN http://bit.ly/2OyZgSN.

(10)  Alex and her friend Steve enter a construction site. Steve doesn’t wear his helmet, but carries it around in his hand. This annoys Alex, since it’s a dangerous site.

Alex: If some construction material fell on your head right now and you wore a helmet, you would probably survive the incident; but if some construction material did fall on your head right now, you would certainly die. So, wear your goddamn helmet.

We also created 20 control items, representing the CONTROL condition, that acted as fillers. These consisted of regular SS, generic conditional sequences, and rSS containing an exhaustifying lexical item (e.g. only). These items were also displayed with an appropriate context.

The total number of conditions were distributed across three lists in a Latin square design:

<table>
<thead>
<tr>
<th>List</th>
<th>Item Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A B C A B C A B C A B C A B C</td>
</tr>
<tr>
<td>II</td>
<td>B A B C A B C A B C A B C A B</td>
</tr>
<tr>
<td>III</td>
<td>A C A B C A B C A B C A B C A</td>
</tr>
</tbody>
</table>

Table 1: Latin square condition lists assigned to participants, the condition SIMILAR represented as A, DISSIMILAR as B, and DISJOINT as C.

<table>
<thead>
<tr>
<th>List</th>
<th>Item order</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>F A F B F F C F A F B F C F A F B F C F A F B F F F C F</td>
</tr>
<tr>
<td>II</td>
<td>F C F A F F B F C F A F B F C F A F B F C F A F B F F F C F</td>
</tr>
<tr>
<td>III</td>
<td>F B F C F F A F B F C F A F B F C F A F B F C F A F B F F F C F</td>
</tr>
</tbody>
</table>

Table 2: Latin square condition lists assigned to participants, target conditions in boldface and fillers represented as F, the SIMILAR condition as A, DISSIMILAR as B, and DISJOINT as C.
The fillers, i.e. control items, were then added to these lists such that no target condition is directly followed by another target condition, yielding the final lists shown in Table 2.

Each participant was randomly assigned to one of the three item lists. Concerning the actual test items themselves, these were also randomly assigned for each participant to each pre-placed condition slot in the randomly assigned item list, whilst the fillers were fixed in place across all lists. As such, each participant had a partially randomised item list specific to them.

There were a total of 48 participants, of which 41 remained after all exclusions. The criteria for exclusion are elaborated upon in § 2.2.

2.2. Method

The experiment itself was an acceptability rating study. Prior to participating in the study, the participants were asked to provide information concerning their age, gender, native language, whether they were raised bilingually, and other languages spoken. They were then asked to sign an agreement, that their anonymised data may be used, statistically processed, and published in its processed, anonymised form. This was followed by an explanation of what they had to do.

The participants were then individually shown and asked to rate the acceptability of each test item on a Likert scale from 1 (=sounds very natural) to 5 (=sounds very unnatural). Upon having rated a test item, the participants had to click a button to continue to the next item. The participants were unable to go back and re-rate an earlier test item.

Participants were excluded if they (i) failed to rate 75% of all control items three or better, (ii) provided an age below 18 or above 65, (iii) consistently rated the experimental items in a systematic fashion (e.g. 1-5-1-5, 1-2-3-4-5, etc.), (iv) were either non-native speakers of English or were raised bilingually, or (v) did not complete the entire experiment run.

The experiment was conducted entirely online, and the participants were gathered from various social network sites. Participation was entirely voluntary and not financially compensated.

3. Results

From the results, it was clear that the control items were rated the most acceptable, followed by the DISJOINT rSS, the DISSIMILAR rSS, and finally by the SIMILAR rSS:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Average Acceptability</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL Condition</td>
<td>1.48</td>
<td>0.45</td>
</tr>
<tr>
<td>DISJOINT Condition</td>
<td>2.15</td>
<td>0.65</td>
</tr>
<tr>
<td>DISSIMILAR Condition</td>
<td>3.41</td>
<td>1.54</td>
</tr>
<tr>
<td>SIMILAR Condition</td>
<td>4.4</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table 3: Average acceptability of each condition, ranked from highest to lowest

We analysed the obtained data with a one-factor ANOVA, which showed a statistically significant difference between groups as determined by one-way ANOVA ($F(3,1021) = 643.1$, $p < .01$). Post hoc conducted one-tailed t-tests between each condition showed that there
is a significant difference between each condition: Comparing the CONTROL condition to the DISJOINT condition, we obtained \( t(204) = -8.8, p < 0.05 \), to the DISSIMILAR condition, \( t(204) = -19.3, p < 0.05 \), and to the SIMILAR condition, \( t(204) = -45.1, p < 0.05 \). Comparing the SIMILAR condition to the DISSIMILAR condition, we obtain \( t(204) = 10.3, p < 0.05 \), and to the DISJOINT condition, \( t(204) = 30.7, p < 0.05 \). Comparing the DISSIMILAR condition to the DISJOINT condition, we obtain \( t(204) = 12.2, p < 0.05 \).

The comparatively high variance of the DISSIMILAR condition led us to take a closer look at its raw data: Intuitively, it seemed that some participants consistently rated these items far lower than other participants. We therefore opted to test our intuition with a k-means clustering analysis, to see if our participants could be divided into more than one population. The cluster analysis of the participants’ results showed that the data could be split into two distinct populations, with relatively high values of confidence. The first population cluster, Cluster 1, consists of 26 participants (i.e. 63% of all participants), and the second population cluster, Cluster 2, consists of 15 participants (i.e. 37% of all participants).

![Silhouette plot of k-means analysis](image)

**Figure 3:** Silhouette plot of k-means analysis of participants by acceptability ratings

Subsequent one-tailed t-tests showed that there are no differences for each condition between population clusters, except for the DISSIMILAR condition with \( t(69) = 10.5, p < 0.05 \). For the CONTROL condition, we obtain \( t(139) = -0.6, p > 0.1 \), for the SIMILAR condition, \( t(69) = 0.7, p > 0.1 \), and for the DISJOINT condition, \( t(69) = 0.3, p > 0.1 \).
For the DISSIMILAR condition, the variance and acceptability is greatly reduced for Cluster 2:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Average Acceptability</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cluster 1</td>
<td>Cluster 2</td>
</tr>
<tr>
<td>CONTROL Condition</td>
<td>1.50</td>
<td>1.44</td>
</tr>
<tr>
<td>DISJOINT Condition</td>
<td>2.13</td>
<td>2.17</td>
</tr>
<tr>
<td>DISSIMILAR Condition</td>
<td>2.87</td>
<td>4.46</td>
</tr>
<tr>
<td>SIMILAR Condition</td>
<td>4.38</td>
<td>4.44</td>
</tr>
</tbody>
</table>

Table 4: Average acceptability of each condition, divided by population cluster

One-tailed t-tests showed that, for Cluster 1, each condition is significantly different to every other condition. Comparing the CONTROL condition to the DISJOINT condition, we obtained $t(134) = -7.2, p < 0.05$, to the DISSIMILAR condition, $t(134) = -12.4, p < 0.05$, and to the SIMILAR condition, $t(134) = -35.6, p < 0.05$. Comparing the SIMILAR condition to the DISSIMILAR condition, we obtain $t(134) = 13.8, p < 0.05$, and to the DISJOINT condition, $t(134) = 23.6, p < 0.05$. Comparing the DISSIMILAR condition to the DISJOINT condition, we obtain $t(134) = 6.4, p < 0.05$.

For Cluster 2, the same one-tailed t-tests showed that each condition is significantly different to every other condition with the exception of the one-tailed t-test between SIMILARITY and DISSIMILARITY, with $t(69) = -0.12, p > 0.1$. Comparing the CONTROL condition to the DISJOINT condition, we obtained $t(69) = -5.1, p < 0.05$, to the DISSIMILAR condition, $t(69) = -23.6, p < 0.05$, and to the SIMILAR condition, $t(69) = -27.7, p < 0.05$. Comparing the SIMILAR to the DISJOINT condition, we obtained $t(69) = 20.1, p < 0.05$. Comparing the DISSIMILAR condition to the DISJOINT condition, we obtain $t(69) = 16.2, p < 0.05$.

Figure 4: Boxplot for Cluster 1 (left) and Cluster 2 (right).
4. Discussion

Our experiment set out to test two independent hypotheses, repeated below.

1. If two rSS are the same except for the degree of similarity between their conditionals’ antecedent worlds, then the rSS whose degree of similarity is more disparate should be considered more acceptable on average.  
   (the dissimilar worlds hypothesis)

2. If the domains of quantification of an rSS are entirely disjoint, there should be no difference in acceptability between them and regular sentences (i.e. the control items).  
   (the disjoint domain hypothesis)

4.1. Dissimilar Worlds Hypothesis

For the dissimilar worlds hypothesis, the experiment yielded somewhat contradictory results. In the previous section, it was shown that, for the undivided participant population, the SIMILAR condition is significantly different from the DISSIMILAR condition and that the DISSIMILAR condition yields higher values of acceptability than the SIMILAR condition by approximately one point of acceptability on average. As such, the hypothesis was technically confirmed, though the difference in acceptability was somewhat smaller and the variance of the DISSIMILAR condition much higher than anticipated. However, the k-means cluster analysis has shown that there are actually two distinct population clusters within our group of participants. Cluster 1 continued to rate the DISSIMILAR condition significantly higher in acceptability than the SIMILAR condition, now by approximately 1.5 points, but Cluster 2 appears to make no distinction between the two conditions whatsoever. Not only that, but the variance for the DISSIMILAR condition in the first population cluster is still very high ($\sigma^2 = 1.21$) and the actual distribution of acceptability judgements disconcertingly even across the board, as seen in Figure 4. As such, it seems that the participants in the first population cluster were unsure of what to do with these rSS, rather than considering them a simple improvement on the SIMILAR condition’s rSS.

Both findings are unexpected by or contradictory to Lewis’ (2018) account, though to different degrees. If considered only on its own, Cluster 2 would directly falsify the dissimilar worlds hypothesis. The variance of Cluster 1 would suggest that dissimilarity – whilst clearly having a positive impact on acceptability in some cases – is not the sole deciding factor (aside from relevance) behind acceptability.

We must consider whether these two findings may be explained by Lewis’ (2018) model in its current state. Concerning Cluster 2, there are two explanations apparent to us: First, as the world closeness is an interaction between similarity and relevance, it might be the case that the participants of this population cluster consistently ascribe enough relevance to the $\phi \land \psi$-worlds s.t. they are always moved to be amongst the closest $\phi$-worlds irrespective of dissimilarity. The second possibility would be that they interpret the DISSIMILAR $\phi \land \psi$-worlds as more similar than intended. The latter option would indicate that there might be an error in the experiment’s design; more specifically, in how the DISSIMILAR condition items were created. The former option would introduce the question why these participants would consistently go through the trouble of rearranging their world ordering – even though most people would not, given the disparity in similarity – if this leads to a contradictory reading. Both by principle of economy
and charitability, it would be more suitable to leave the $\phi \land \psi$-worlds in their original place in the world ordering, given the vast distance they would have to cross to count amongst the closest $\phi$-worlds. Concerning the variance of the first population cluster, we have a similar option to argue in favour of Lewis’ (2018) model: If we were to assume that the $\phi \land \psi$-worlds of the DISSIMILAR condition are regarded as more similar than intended, then the participants might be more inclined to provide them with lower acceptability ratings – the higher ratings would then be an act of charitable interpretation on their part. This would however raise the question why their charitability – a successful strategy – is only intermittently employed.

Excluding, for the sake of argument, the possibility of there being an inherent flaw in the design of the DISSIMILAR rSS and assuming that Cluster 2 is not that anti-charitable, we would argue that our results, whilst weakly supporting the dissimilar worlds hypothesis, are more contradictory to than supportive of Lewis’ (2018) model. Rather, the data would suggest to us that there is another main factor behind the acceptability of rSS, as further explored in § 4.3.

4.2. Disjoint Domain Hypothesis

Concerning the disjoint domain hypothesis, things are a bit more clear: Since there is a significant difference between the CONTROL condition and the DISJOINT condition, and the latter is less acceptable on average, the null hypothesis has been falsified. However, the DISJOINT rSS are, on average, only 0.67 points less acceptable than the control items. They are also far more acceptable than the other types of rSS. We reckon that this slight – though significant – degradation in acceptability may be chalked up to the markedness of rSS in general: The markedness of going from a specific case to a more general case that then seemingly contradicts the specific case, even if only on the surface. Generally speaking, in language, the reverse appears far more common (e.g. precisification). In the same line of reasoning, it appears, to us at least, quite difficult to find a natural occurrence of rSS within any given corpus – written or spoken.

4.3. Further Introspective Judgments

In § 4.1, we argued that the experimental results suggest that relevance and dissimilarity may not be the only important factors for the acceptability of rSS – perhaps not even the main ones. What, then, renders rSS acceptable in the rare instances when this is the case? From the results of the DISJOINT condition, we know that its ingredients are a recipe for (limited) success. Recalling the conditions for their creation from § 2.1, we know them to be (i) establishing the $\phi \land \psi$-conditional as counterfactual (by meaning, if not by syntax), whilst making the $\phi$-conditional a regular future-less-vivid conditional and (ii) having both sequence conditionals share a common discourse goal explicitly named by a sentence following the rSS. As such, we tried to pin down what makes an rSS acceptable by systematically creating rSS with only one of these features or even neither of them whilst trying to keep the changes to a minimum.

(11) **Counterfactual + Unified Discourse Purpose**

(Said, over the telephone, to someone who is completely alone by a frozen lake, though 15 minutes away from the lake, there are some people who have told him that they definitely won’t be coming to the lake, unless he came and told them he needed them.)

Yes, if you walked on the thin ice right now while being supported by someone on the shore, the ice wouldn’t break and you’d be fine; but if you DID walk on the thin ice
right now, the ice would break and you would die! So, if you really want to walk on it, go and fetch one of those people you told me about!

(12) **Counterfactual + No Unified Discourse Purpose**

(Said, over the telephone, to someone who is completely alone by a far-off frozen lake with nobody even remotely in the vicinity.) Yes, if you walked on the thin ice right now while being supported by someone on the shore, the ice wouldn’t break and you’d be fine; but if you DID walk on the thin ice right now, the ice would break and you would die! So, don’t walk on the thin ice!

(13) **Not Counterfactual + Unified Discourse Purpose**

(Said, over the telephone, to someone who is currently planning on going to a remote frozen lake next week. It is known that said person has not decided on going completely alone.) If you walked on the thin ice next week while being supported by someone on the shore, the ice wouldn’t break and you’d be fine; but # if you DID walk on the thin ice next week, the ice would break and you would die! So, only walk on the ice if you have someone with you!

(14) **Not Counterfactual + No Unified Discourse Purpose**

(Said, over the telephone, to someone who is currently planning on going to a frozen lake next week.) If you walked on the thin ice next week while being supported by someone on the shore, the ice wouldn’t break and you’d be fine; but # if you DID walk on the thin ice next week, the ice would break and you would die! So, don’t walk on the thin ice!

From this, it would appear that only counterfactuality is strictly needed for a felicitous rSS. The $\phi \land \psi$-conditional in (12) does not really support the goal of convincing the person near the lake not to walk upon the thin ice – at best, it does not detract from said goal, since it mentions a non-possibility with no direct bearing on the situation. In that sense, (12) is not unequivocal in the sense of being a “single pointful piece of discourse” (Edgington, 1995), i.e. sharing a common discourse purpose, though still unequivocal in the sense of the speaker not changing their mind or retracting their previous statement (Klecha, 2015).

The requirement of actual counterfactuality appears too strict, however: As seen below, rSS may be felicitous if the possibility of $\phi \land \psi$ has merely been epistemically excluded from occurring, though, in reality, it remains an option, no matter how unlikely:

(15) **Epistemically Excluded Possibility**

(Said, over the telephone, to someone who is currently planning on going to a remote frozen lake next week that is known for usually nobody ever going there. It is known that said person has decided on going completely alone and is extremely adamant about it, because he wants get away from everything.) Listen, if you walked on the thin ice next week while being supported by someone on the shore, the ice wouldn’t break and you’d be fine; but if you DID walk on the thin ice next week, the ice would break and you would die! So, I’m begging you to be careful and not to go on the ice!

With this, we may have identified the factor that threw off the results for the SIMILAR rSS. However, considering how inconclusive the results for this condition were, we also further examined Lewis’ (2018) criterion it was based upon: The hypothesis that two differently similar
sets of worlds may intermingle due to relevance if the worlds in question are “similar enough”. To this effect, we created a scenario that fulfilled the previously identified criterion of counterfactuality with only a minimal difference in similarity:

(Said to John, who is at a remote cabin next to a frozen lake with some friends. John asked whether they wanted to go for a walk, but all of them declined, even though Mary nearly agreed.) If Mary hadn’t decided against coming with you and you had walked on the ice supported by her from the shore, the ice wouldn’t have broken; but if you HAD walked on the thin ice, the ice would’ve broken. You made the right choice.

Considering that (16) seems felicitous and that we have found no rSS for which dissimilarity appears to play a role in felicity (short of the \( \phi \wedge \psi \)-worlds being so dissimilar that they ought to be considered excluded possibilities), we would argue that this criterion may be formally dropped: Any two sets of worlds appear similar enough so long as there is no counterfactuality or epistemically excluded possibility involved. These could be summed up as perceived non-reality worlds. Only if an rSS involves a set of perceived non-reality worlds does similarity play a role in whether or not the sequence is rendered felicitous or infelicitous.

Another point of interest is the stress on the auxiliary verb: The placement of the stress in the experimental items is easily motivated, since the \( \phi \)-antecedent’s did was the only lexical item not found within both antecedents. However, for counterfactual rSS, such as the one in (16), the matter is somewhat more complicated, since the stressed auxiliary verb had is part of either conditional’s antecedent. This technically violates Klecha’s (2015) constraint on rSS that the second conditional’s antecedent may not be a syntactic subset of the preceding conditional, so as to allow for contrastive stress of some kind. Rather, here, the contrastive stress appears obligatorily placed upon the auxiliary verb had, as the same rSS is rendered less acceptable if the stress is prevented from being placed upon it – e.g. by using a contraction:

(Said to someone who had just been completely alone by a frozen lake) If you had walked on the thin ice while being supported by someone on the shore, the ice wouldn’t have broken; ?? but if you’d walked on the thin ice, the ice would have broken.

The acceptability is somewhat increased, if the stress is shifted to the verb, but appears not to reach the same levels of acceptability as rSS where the auxiliary verb is stressed.

4.4. Possible Accounts

Here, we sketch out two possible, not necessarily mutually exclusive ways to account for both the data gathered in the experiment and the introspective data of the previous subsection.


First, we attempt to reconcile the data with Lewis’ (2018) system with minimal modifications: As discussed in the previous section, the notion of the two antecedent world sets having to be similar enough has been somewhat discredited. As such, we would propose to eliminate this criterion so long as no appropriate example that is clearly in its favour has been found. The previous section has shown that counterfactuality or the epistemic exclusion of possibility appears to be the main driving factor behind rSS felicity.
To account for this, we propose to install a further restriction on the relevance-induced movement of worlds: If a world is no longer a live possibility, then said world cannot move any closer to the evaluation world than its original value of similarity. In other words, similarity acts as a hard upper limit imposed upon world closeness when it comes to counterfactuals. Intuitively, this may be explained as follows: Counterfactuals range over worlds that are, by definition, no longer possible. Even if we put much relevance into what might have happened, this does not make said worlds appear any more close, similar, or familiar to the actual world. For conditionals that range over live possibilities, on the other hand, similarity may rather be seen as a metric for expectation, and expectations are rather malleable by nature.

For epistemically excluded possibility worlds, there are two options: First, to analyse them as counterfactual worlds. Second, to assign to them a relevance value so marginal that salience alone has no discernible impact upon the closeness of these worlds (i.e. they are so irrelevant that they do not move closer to the evaluation world, even if mentioned).

With this, we would already explain why the DISJOINT rSS are so acceptable and why the DISSIMILAR rSS are not rated any higher than the SIMILAR rSS for Cluster 2: Even though they may quantify over dissimilar and highly improbable worlds, they do not approach the same level of epistemic exclusion as (15) does and, therefore, move close enough to count amongst the closest ϕ-worlds. The respective results of Cluster 1 may be explained by an assumption of charitability: Cluster 1 participants actively try to accommodate for the rSS to be felicitous by attempting to interpret the extreme dissimilarity between the ϕ ∧ ψ-worlds and ϕ-worlds as a sign for the epistemic exclusion of ϕ ∧ ψ as a possibility, even though this is not explicitly stated or sufficiently alluded to within the context. Dissimilarity being an unreliable factor for this kind of accommodation then causes the results to fluctuate out of control or, in other words, causes the participants’ confusion regarding these matters.

These modifications have very little impact upon Lewis (2016, 2018). Aside from her reasoning on the infelicity of rSS, essentially all of her points are left functionally untouched: Her analysis for the problem of counterfactual scepticism remains as is, and Krassnig’s (2017) reunification of Lewis sequences and True Sobel sequences into a single phenomenon, using Lewis’ (2018) model and Bennett (2003) or Arregui’s (2009) similarity metric, should also remain unaffected.

4.4.2. Contrastive Stress Account

The second attempt to account for the data within this paper would be to take a closer look at contrastive stress and the role it plays in rSS – something we have so far ignored in Lewis’ (2018) account. Specifically, its effect on the auxiliary verb and why the stress is obligatorily placed upon it if there is a lack of better alternatives, as previously demonstrated with (15) and (17). Optimally, any analysis that accounts for this would also account for why the similarity values between ϕ ∧ ψ and ϕ must be clearly different6 and why, for non-counterfactuals, epistemic exclusion of possibility appears necessary, but simple unlikelihood does not. To achieve this, we need to make two main assumptions that have already been argued for and

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6This may appear a trivial requirement but is far from it. A broad, simple exhaustification-based account, for example, might lead to an analysis along the lines of interpreting appropriately stressed rSS as “ϕ ∧ ψ□→χ”, but ϕ ∧ ¬ψ□→¬χ”, which would yield felicity regardless of similarity. Something that would contradict our empirical and introspective findings and would turn even reverse Lewis sequences felicitous.
been independently motivated in the literature: (i) We assume that focus or stress on a bound pronoun and other anaphoric lexical items of this kind affects not the function meaning of the pronoun but rather the domain of its binder (Jacobson, 2004: p. 155ff.). (ii) We also assume that the antecedents of conditionals actively set the current aboutness topic (Ebert et al., 2008), not only for conditionals, but also for counterfactuals (Ebert et al., 2008: p. 139).\footnote{Strictly speaking, Ebert et al. (2008) only claim that antecedents act as aboutness topics when they are fronted (i.e. they precede their consequent). In our experiment and the remainder of this paper, we have only considered and analysed such fronted antecedent conditionals. As such, the topicality of non-fronted antecedents is not of immediate concern. However, should rSS prove just as acceptable with non-fronted antecedents – given otherwise identical conditions – then this will have to be addressed. In such a case, if this account was to extend to rSS without fronted antecedents, the topicality of fronted antecedents would most likely have to be extended to non-fronted antecedents as well.}

With these assumptions in mind, we refer to the fact that tense and mood have, in one way or another, frequently been associated with the world selection process of the antecedent for the subsequent evaluation of the consequent (see, amongst others, Palmer, 1986; Iatridou, 2000; Arregui, 2009; Romero, 2014; Schulz, 2014). We posit that, lacking any available difference in syntax, the only difference in semantics – the difference in the selection of worlds – is the target for the obligatory contrastive stress. The auxiliary verb is merely stressed because it is bound by the tense and mood of the antecedent and stressing it therefore directly affects its binder’s domain. This is analogous to how the focus effect of a stressed bound pronoun does not affect the pronoun itself but rather the domain of its binder (Jacobson, 2004: p. 155ff.). However, rather than assuming that this contrastively used stress yields a simple exhaustifying implicature, i.e. that the $\phi$-conditional is effectively interpreted as $\phi \land \neg \psi$, we assume that this is a case of contrastive (aboutness) topic – since the antecedents, in general, represent the aboutness topics of their respective conditional (Ebert et al., 2008). However, for a contrastive aboutness topic to actually be contrastive, the contrastive topic needs to be necessarily different from the topic it is contrasted against. If a contrastive topic construction is used, such as some fronting construction, but the sentence in question refers to an already present aboutness topic, the acceptability of said utterance degrades greatly (see, amongst others, Reinhart, 1981; Büring, 2016). See the following classical example, adapted from Reinhart (1981: p. 63):

\begin{enumerate}
  \item Felix is an obnoxious guy.
  \item Even Matilda can’t stand him.
\end{enumerate}

The degradation in acceptability in (19) is blamed by Reinhart (1981) on the fact that (19a) sets Felix as the aboutness topic, (19b) then contrastively sets Mathilda as the current aboutness topic, yet loops back to a sentence that is still quintessentially about the previous aboutness topic: Felix. For rSS with contrastive stress on the auxiliary verb, something very similar happens. The contrastive stress (or accent) on the auxiliary verb marks the antecedent not only as a contrastive aboutness topic, but also specifies in which regard the current topic deviates from the previous one: The domain of worlds under which the consequent is to be evaluated.

The regular rSS pattern could therefore be paraphrased along the lines of (19):

\begin{enumerate}
  \item In all the closest $\phi \land \psi$-worlds, $\chi = 0$ needs to be the case.
  \item As for all the closest $\phi$-worlds, $\chi = 1$ needs to be the case.
\end{enumerate}
The contrastive marking of the φ-antecedent therefore tries to introduce an entirely new aboutness topic. If the closest φ ∧ ψ-worlds were just as close to the evaluation world as the closest φ-worlds, then this would entail that the set of the closest φ ∧ ψ-worlds is a subset of the set of closest φ-worlds.\(^8\) We would, therefore, not strictly introduce a new aboutness topic, but rather loop back to the old one, even though we may add a couple of worlds in the process. We believe that, in addition to the semantic contradictions that may arise, the failure to introduce an adequately contrastive aboutness topic is responsible for the unacceptability of rSS whose antecedents’ world similarity values are either identical or unclear. Furthermore, if no contrastive stress / topic is found, then the φ-conditional may be interpreted as still belonging to the same aboutness topic as before – motivating a modal subordination reading of the φ-conditional, yielding a contradiction, motivating a proposal such as Klecha’s (2015: p. 136). Generalising all of this, we argue that the topicality of antecedents therefore enforces, pragmatically, that a difference in similarity between the rSS’ antecedent worlds needs to be clearly distinguishable.

This would explain the results of the DISJOINT condition and also account for our introspective observation that the difference in dissimilarity need only be minimal, yet clearly delineated. Yet, this still leaves open why indicatives and future-less-vivid conditionals are generally infelicitous, short of epistemically excluded possibilities. Why this is strictly the case needs to be further developed, though it is likely linked to the fact that, for live possibility worlds, the similarity ordering is, by nature, far less clearly demarcated than their counterfactual counterparts’.

For a more developed, formalised account of this nature, we would refer to Krassnig (in prep.).

5. Conclusion

We have shown that dissimilarity’s role is contrary to Lewis’ (2018) reasoning: Rather than two sets of worlds having to be similar enough to one another in order for rSS to become infelicitous, any clear-cut degree of dissimilarity is enough to render rSS felicitous. That is, so long as the rSS in question is either a counterfactual or treats the closest φ ∧ ψ-worlds as epistemically excluded possibilities. We have also shown that contrastive stress need not necessarily require an overtly different item but may also target semantic differences – e.g. when the φ-antecedent’s auxiliary verb of a counterfactual rSS is stressed. We have sketched out two accounts: a modification of Lewis (2018) s.t. her predictions are more in line with our results and one account that motivates why contrastive stress is necessary, why contrastive stress may fall upon the auxiliary verb (obligatorily so, lacking any other candidates), and why the dissimilarity requirement is enforced not only on a semantic level but also at the level of discourse. Concerning future research, we believe it necessary for further rSS experiments to be conducted, as there is a lot left to uncover or confirm with regards to what makes and what unmake rSS (in)felicity. The contrastive topic account also requires further formalisation and exploration – for instance, regarding the (in-)felicity of rSS whose antecedents are not fronted. Further independent motivation for relevance interacting with world similarity to bring about world closeness would also be a worthwhile avenue, to better independently motivate such a model apart from the problem of counterfactual scepticism, rSS, and similar conditionals.

\(^8\)The entailment would either hold true due to world closeness being equal to world similarity (Stalnaker, 1968; Lewis, 1973) or, carrying over the assumptions from § 4.4.1, because the φ ∧ ψ-worlds would automatically get pushed to be as close to the evaluation world as they are similar to it, upon becoming salient, under our modified account of Lewis (2018) – at least insofar as counterfactuals are concerned.
References


Condition C effects in VP fronting constructions and the mode of semantic composition

Petr KUSLIY — Institute of Philosophy, Russian Academy of Sciences

Abstract. The paper studies Condition C effects in VP fronting constructions. The author explores new as well as known data that cannot be accounted for by current theories of reconstruction. He explores the mode of semantic composition by which the fronted verb composes with its sister in cases where Condition C effects are triggered and obviated. The author proposes that Condition C effects are triggered if a potential trigger inside a fronted VP is argument to a predicate that describes a situation that is identical to or co-varies with the Austinian topic situation described by the assertive content of the whole sentence.

Keywords: VP fronting, connectivity, Condition C, reconstruction, situation semantics, Restrict, argument identification.

1. Introduction

As defined in Chomsky (1981), Condition C of binding theory is a disjoint reference effect between an R-expression and a c-commanding pronoun. If co-indexation between a pronoun and an R-expression suggests that they have the same denotation, then (1) violates Condition C, whereas (2) does not.

(1) *She₁ said I criticized Mary₁.
(2) Mary₁ said I criticized her₁.

Fronted predicates in general and fronted VPs in particular pattern with their non-fronted variants in triggering the Condition C effect.

(3) *Criticize Mary₁, she₁ said I did.
(4) Criticize her₁, Mary₁ said I did.

Takano (1995) proposed that fronted VPs (and other predicates) obligatorily reconstruct at LF and that Condition C is checked at LF. Reconstruction of fronted predicates for Condition C has recently been confirmed in Adger et al. (2016) and Bruening & Al Khalaf (2019). In what follows, I assume that all fronted predicates undergo obligatory syntactic reconstruction at LF.

1.1. Heycock’s Puzzle

Heycock (1995) observed that there is a contrast between sentences like (5) and (6):

(5) *Recommend a student that John₁ taught, he₁ said Mary did.
(6) Recommend the student that John₁ taught, he₁ said Mary did.

1 I would like to thank Kyle Johnson, Rajesh Bhatt, Barbara Partee, Seth Cable and Katia Vostrikova for discussing the content of this paper with me and helping me improve on my thoughts. All errors are mine.

These data are puzzling because if fronted predicates reconstruct at LF, then both sentences are predicted to exhibit the Condition C effect and the contrast is unexpected. The difference between (5) and (6) is just the determiner: when an R-expression occurs inside an indefinite object to a fronted verb, the Condition C effect is triggered, and when it occurs inside a definite object, the Condition C effect is obviated. Importantly, the non-fronted versions of (5) and (6) exhibit no contrast and both violate Condition C:

(7) *He said that Mary recommended a student that John taught.
(8) *He said that Mary recommended the student that John taught.

The puzzle then is to explain the contrast in (5) and (6) and lack thereof in (7) and (8).

1.2. Extending Heycock’s puzzle: novel data

I provide novel data suggesting that Heycock’s puzzle is not just about indefinite vs. definite objects to fronted verbs. Other weak DPs (in the sense of Milsark (1977)) also pattern with indefinite objects to fronted verbs in triggering the Condition C effect between an R-expression they embed and a co-indexed matrix pronoun:

(9) *Recommend some students that John taught, he said Mary did.
(10) *Recommend many students that John taught, he said Mary did.

Strong DP objects on the other hand pattern with definite objects and bleed Condition C.

(11) Recommend every student that John taught, he said Mary did.
(12) Recommend most students that John taught, he said Mary did.

CP complements to fronted verbs pattern with weak DP objects in feeding Condition C:

(13) *Think that Mary arrived on time, she did.

The reconstruction puzzle we are dealing with is now even more complicated. It also has to do with the contrast between weak and strong objects and CP complements.

1.3. Overview of the paper

In the rest of this paper, I explore this puzzle and propose a new perspective on the environments in which Condition C effects arise. I proceed in the following order.

Section 2 shows that Heycock’s puzzle enriched with the novel data is a challenge for current theories of connectivity in fronting constructions. In section 3, I propose three questions that must be answered in order for this puzzle to be solved. (In this paper, I provide answers only to the first two.) Section 4 provides data showing that adjuncts to fronted verbs are environments that feed Condition C effects and thus pattern with weak DP objects and CP.
complements to fronted verbs. In section 5, I propose that what unites adjuncts and complements to fronted verbs in which Condition C effects arise is their mode of semantic composition with the verb. They all compose with the verb by a mode of composition known as Restrict, which involves identification of unsaturated arguments. In those environments where connectivity for Condition C is obviated, the semantic composition does not involve argument identification. Section 6 extends this observation to relative clauses inside weak and strong DP objects of fronted verbs. It is shown that a relative clause inside a weak object describes a situation that is semantically dependent on the situation described by the verb (i.e. is identical to or co-varies with it). Relative clauses inside strong DPs describe situations that are semantically independent of those described by the verb. Section 7 shows how the proposal can be extended to complement CPs. In section 8, I invoke the notion of the Austinian topic situation known from situation semantics and propose that if an embedded predicate in a fronting construction describes a situation that is semantically dependent on the Austinian situation, the arguments of this predicate are subject to Condition C effects. Section 9 concludes and provides an outlook into further research.

2. The challenge for current accounts of reconstruction

Heycock (1995) suggests that the contrast between sentences like (5) and (6) can be predicted even under the assumption that fronted VPs obligatorily reconstruct, if we further assume that definite descriptions can exceptionally scope out from the reconstructed position to a position above the c-commanding pronoun. However, in light of the new data it is not clear how this proposal could be carried out for a sentence like (11), since universal quantifiers are not expected to scope out of a complement CP. Moreover, it is not clear why the definite cannot scope out to avoid Condition C effects in non-fronting constructions like (8).

Late merge accounts that allow an adjunct of a fronted constituent not to reconstruct (e.g. Lebeaux, 1988; Romero, 1998; Sauerland, 1998; Fox, 1999; Takahashi & Hulsey, 2009) predict that (5), (9), (10) should be acceptable: in all these cases, the offending proper name is inside an adjunct, but the Condition C effect is not obviated.

Accounts that prohibit “deep” late merge, i.e. late merge to an embedded position (Landau, 2007; Hunter & Frank, 2014), are unable to explain the acceptability of (6), (11), (12), where an R-expression occurs inside an adjunct in the projection of a noun, which is not the first maximal projection. The structure is incorrectly predicted to be ruled out.

Sportiche’s (2016) theory called Neglect allows one to ignore any material at any interface, as long as at least one copy is interpreted. This theory offers some correct predictions for many instances of Heycock’s puzzle. In particular, it predicts the unacceptability of (5) under a de dicto interpretation, which requires the indefinite to be interpreted in the low position. Neglect predicts the lack of Condition C effects under the de re interpretation of the indefinite in (5).

Indeed, making the de re interpretation of the indefinite in (5) more salient by adding certain significantly reduces the disjoint reference effect:

(14) Recommend a certain student that John taught, he said Mary did.
However, Neglect does not seem to explain the contrast observed in simple extensional cases:

\[(15) \begin{align*}
    a. & \text{Criticize a student that John recommended, he did.} \\
    b. & \text{Criticize the student that John recommended, he did.}
\end{align*} \]

Here, there is no contrast between the \textit{de re} and \textit{de dicto} interpretation: no matter which copy of the indefinite in \(15\)\(a\) is interpreted, the truth conditions are the same. If so, then we should expect an obviation of the disjoint reference effect in \(15\)\(a\). Yet, this is not what we observe: the structure is ruled out.

Krifka (2018) develops an account of reconstruction effects in terms of semantic reconstruction and competition between co-reference and binding (cf. Cresti, 1995; Jacobson 1999; Reinhart, 1983). He argues that all fronting configurations can be interpreted in surface position if we allow higher type traces and adopt the variable-free approach to binding. A fronted phrase associated with a higher type trace receives a narrow scope interpretation in its surface position. Because of this, an R-expression inside such a phrase is never c-commanded by a co-referential pronoun and the configuration for Condition C does not obtain. According to this perspective, the degradedness of \(15\)\(a\) actually arises from a competition between \(15\)\(a\) and a competitor like “Criticize a student that he recommended, he did”, where the embedded pronoun \textit{he} is of type \textit{<e,e>}. Together with certain rules of semantic composition, such a configuration licenses a “bound” interpretation of the pronoun \textit{he} with respect to the matrix subject. Due to the general preference for anaphora via binding, \(15\)\(a\) is ruled out in favor of its competitor. As convincing as Krifka’s arguments are, it is not immediately clear why the same reasoning would not rule out \(15\)\(b\) (as well as \(6\), \(11\), \(12\)) and how the contrast between examples like \(15\)\(a\) and \(15\)\(b\) can be predicted.

Finally, some theories of reconstruction develop Sharvit’s (1998) argument that reconstruction for scope does not feed Condition C whereas reconstruction for opacity does (see Lechner, 2013, 2018 and Keine & Poole, 2018). Such theories are known as hybrid because they combine the analytic potential of structural approaches like Neglect and those that appeal to semantic reconstruction in terms of higher type traces. According to Keine & Poole (2018), when A-bar movement undergoes obligatory reconstruction, the reconstruction can proceed either by the mechanism of Neglect (mentioned above) or by the mechanism of semantic reconstruction (which allows for higher type traces). Their account successfully predicts the data they discuss. However, it is not clear how the contrast that constitutes Heycock’s puzzle could be accounted for by a hybrid approach. As was shown above, the relevant contrasting cases are instances of the same kind of movement (VP fronting), so whatever options for reconstruction are available in cases that trigger Condition C effects should also be available in those cases where these effects are obviated. Moreover, extensional examples like \(15\)\(a\) do not involve reconstruction for opacity in the first place and it is not clear why such examples reveal Condition C effects in the first place. I conclude that hybrid accounts as formulated by the abovementioned theorists do not provide a ready solution to Heycock’s puzzle.

3. Desiderata from an account

\(^2\) But see his discussion of factors like topicality, specificity, etc., which can affect acceptability judgments.
I believe that an account that aims to capture the data in the above examples must be able to provide answers to the following three questions:

Question 1. What determines the contrast exhibited by weak objects to fronted verbs in examples like (5), (9), (10), on the one hand, and the strong objects in examples (6), (11), and (12), on the other?

Question 2. Why do CP complements to fronted verbs pattern with weak DPs (ex. (5), (13))?

Question 3. Why does the contrast between strong and weak objects to fronted verbs arise only in fronting constructions? As was shown in (7) and (8), non-fronting configurations trigger the Condition C effect no matter whether the offending proper name is inside a weak or a strong object.

In what follows, I provide an account of the environment in which Condition C effects are triggered in VP fronting constructions and thus provide answers to the first two questions, leaving the third one for future research.

4. Adjuncts to fronted verbs feed Condition C

Heycock (1995) observes that proper names inside adjuncts to fronted predicates trigger Condition C effects:

(16) *How pleased with Pollock$_1$ do you think he$_1$ really was? (Heycock 1995, ex. 23a)

I show that proper names in adjuncts to fronted verbs also trigger the disjoint reference effect with matrix co-indexed pronouns that c-command the base position of the VP:

(17) a. Leave without her$_1$, Mary$_1$ thought you never would.
    b. *Leave without Mary$_1$, she$_1$ thought you never would.

(18) a. Sit next to him$_1$, John$_1$ said Mary did.
    b. *Sit next to John$_1$, he$_1$ said Mary did.

If, however, a potential Condition C trigger occurs inside a definite (or, more generally, strong) DP that is argument to a fronted predicate or is inside an adjunct to a fronted predicate, the Condition C effect is obviated:

    a. How pleased with the pictures Pollock$_1$ painted in his youth do you think he$_1$ really was?
    b. How afraid of the people Gore$_1$ insulted years ago do you think he$_1$ is now?

(20) Leave without the girl who hates Mary$_1$, she$_1$ said you never would.
(21) Sit next to every guy who knows John$_1$, he$_1$ said Mary did.
Finally, if the same potential Condition C trigger is inside a weak DP in the same configuration, the Condition C is again triggered:

(22) *Leave without a girl who hates Mary, she said you never would.
(23) *Sit next to a guy who knows John, he said Mary did.

What this shows is that adjuncts to fronted verbs pattern with complement CPs (ex. (13)) and weak DP objects to fronted verbs (ex. (5), (9), (10)): they feed Condition C. What can account for this pattern? What is common among adjuncts, weak DP objects and CP complements? In the next section, I propose that it is the mode of semantic composition with the verb.

5. The mode of semantic composition: Predicate Modification and Restrict

In this section, I discuss Restrict as the mode of semantic composition by which modifiers and weak DP objects compose with verbs. I show that Restrict involves an important step of argument identification. When a verb combines with a strong DP, the mode of composition is Functional Application. I present this discussion in terms of situation semantics.

5.1. Predicate Modification in situation semantics and identification of arguments

In situation semantics, predicates are viewed as taking a situation argument in addition to an individual argument (type <e, <s,t>>). Predicate Modification requires the situation arguments of each predicate as well as their individual arguments to be identified. Keshet (2008b) argues that examples like (24) are anomalous because the two predicates in the restrictor of the subject, namely U.S. Senator and at Harvard, must be interpreted against the same situation, which leads to the anomalous interpretation:

(24) #In 1964, every U.S. Senator at Harvard got straight A’s.

Keshet’s (2008a) Intersective Predicate Generalization states that two predicates that intersect may not be evaluated at different times and worlds. Thus, when U.S. Senator and at Harvard in (25) and (26) intersect to create the complex predicate U.S. Senator at Harvard, their individual and situation arguments are identified:

(25) [U.S. Senator] = [λx . λs . x is a U.S. Senator in s]
(26) [at Harvard] = [λx . λs . x is at Harvard in s]
(27) [U.S. Senator at Harvard] = [λx . λs . x is a U.S. Senator in s and x is at Harvard in s]

5.2. Verbal modification by Restrict and argument identification
Assuming that intransitive verbs are relations between individuals and situations (type $<e, <s, t>>$), we get the following lexical entry for a verb like *leave*:

\[(28) \quad \llbracket \text{leave} \rrbracket = [\lambda x . \lambda s . x \text{ leaves in } s] \]

Verbal modifiers like *without Mary* are predicates of situations (expressions of type $<s, t>$):

\[(29) \quad \llbracket \text{without Mary} \rrbracket = [\lambda s . s \text{ is without Mary}] \]

The semantic composition of verbs and verbal modifiers cannot proceed by Predicate Modification. Chung & Ladusaw (2004) propose the rule known as Restrict (Predicate Restriction). I provide the following definition for Restrict:

\[(30) \quad \text{If } \alpha \text{ has two daughters } \beta \text{ and } \gamma, \text{ such that } \llbracket \beta \rrbracket \in D_{<e, <s, t>>} \text{ and } \llbracket \gamma \rrbracket \in D_{<e, t>}, \text{ then } \llbracket \alpha \rrbracket \in D_{<e, <s, t>>} \text{ and } \llbracket \alpha \rrbracket = [\lambda x . \lambda y . \llbracket \beta \rrbracket(x) \& \llbracket \gamma \rrbracket(x)]. \]

What Restrict does is identify a predicate’s argument with the first argument of a transitive verb, so that the predicate becomes a modifier of the corresponding argument of the verb in the resulting complex predicate.

A version of Restrict that allows a predicate to modify the second and not the first argument of the function it composes with can be used to compose (28) and (29) and generate (31):

\[(31) \quad \llbracket \text{leave without Mary} \rrbracket = [\lambda x . \lambda s . x \text{ leaves in } s \text{ and } s \text{ is without Mary}] \]

5.3. Weak DPs compose with transitive verbs by Restrict

As defined by Milsark (1977), weak DPs are those that can occur in existential constructions and strong DPs are those that cannot:

\[(32) \quad \text{There was a student that John taught.} \]
\[(33) \quad \text{There were (some) students that John taught.} \]
\[(34) \quad *\text{There was the student/every student that John taught.} \]
\[(35) \quad *\text{There were most students that John taught.} \]

Partee (1986) showed that weak DPs can occur in predicative positions (such as those inside small clauses), whereas strong DPs cannot not:

\[(36) \quad \text{I consider John smart/a student.} \]
\[(37) \quad *\text{I consider John the student.} \]

---

3 In the neo-Davidsonian tradition (e.g. Parsons, 1990) verbs are treated as predicates of events (entities of type $e$). I assume here that situations can substitute events in the lexical entries of verbs.

4 Kratzer (1996) argues that a verb’s external argument is severed from it. Under this perspective, *leave* would be an expression of type $<s, t>$ and its compositions with the modifier would proceed by Predicate Modification and not by Restrict. The verb’s and the modifier’s situation arguments would still be identified.
The pivot nominal in an existential construction is known to be property denoting (McNally, 1998). This suggests that in predicative, non-argument positions weak DPs behave as predicates and strong DPs do not.

Musan (1995) showed that the temporal interpretation of weak DPs is dependent on the interpretation of the main predicate:

(38)  #There is a fugitive in jail.

Sentence (38) is anomalous because the weak DP *a fugitive* must describe the same situation that is described by the main predicate *is in jail* and we do not expect this to be possible.

McNally & Van Geenhoven (1998) argue that weak DPs in object positions also behave as predicates that do not introduce a discourse referent. Weak DP objects describe the same situation as the verb that takes them as complement (Schwarz, 2009).

The interpretation of a VP like *recommend a student* can derived in the following way. *Student* is a relation between individuals and situations with the lexical entry in (39). The weak indefinite determiner is an identity function with the lexical entry in (40). The resulting interpretation of the weak DP *a student* is given in (41):

(39)  $\llbracket \text{student} \rrbracket = [\lambda x . \lambda s . x \text{ is a student in } s]$

(40)  $\llbracket \text{a weak} \rrbracket = [\lambda P_{<e,st>} . P]$

(41)  $\llbracket \text{a student} \rrbracket = [\lambda x . \lambda s . x \text{ is a student in } s]$

A transitive verb like *recommend* is of type $<e,<e,<s,t>>$:

(42)  $\llbracket \text{recommend} \rrbracket = [\lambda y . \lambda x . \lambda s . x \text{ recommends } y \text{ in } s]$

The semantic composition of such a verb with a weak object DP of type $<e,<s,t>>$ cannot proceed by Functional Application. It proceeds by a version of Restrict that allows the weak DP to identify both of its unsaturated arguments with the internal individual argument and the situation argument of the verb respectively. The resulting expression *recommend a student* is still of the transitive type $<e,<e,<s,t>>$:

(43)  $\llbracket \text{recommend a student} \rrbracket = [\lambda y . \lambda x . \lambda s . y \text{ is a student in } s \text{ and } x \text{ recommends } y \text{ in } s]$

Weak DP objects thus describe the same situation that is described by the main predicate.

In the resulting expression, the unsaturated internal argument position is closed as a next step in the derivation of meaning by the operation of Existential Closure, which introduces an existential quantifier that binds the internal argument position in the complex predicate:

(44)  If $P$ is an n-place predicate that takes arguments $a_1, a_2, \ldots, a_n$ in the order of the numeration and $a_i \in D_e$, then $\llbracket \exists P \rrbracket = [\lambda a_2 . \ldots . \lambda a_n . \exists x(\llbracket P \rrbracket(x)(a_2)\ldots(a_n))$]
After Existential Closure has applied, the VP recommend a student receives the structure in (45) and the interpretation in (46). It thus gets its familiar interpretation of type $\langle e, s, t \rangle$.

\begin{align*}
(45) & \quad [VP_{e,t}] \exists [VP_{e,t}] \text{recommend}_{e,t} [DP_{e,t}] \alpha_{e,t} [NP_{e,t}] \text{student}]])) \\
(46) & \quad \llbracket (45) \rrbracket = [\lambda x . \lambda s . \exists y (y \text{ is a student in } s \text{ and } x \text{ recommends } y \text{ in } s)]
\end{align*}

5.4. Strong DP objects do not compose with verbs by Restrict

As was mentioned above, strong DPs are unacceptable in predicative positions. Enç (1986) showed that the temporal interpretation of a strong DP is independent from that of the main predicate. Sentence (47) can be understood to have an interpretation according to which every person who was a fugitive at a past time is now in jail.

\begin{align*}
(47) & \quad \text{Every fugitive is in jail.}
\end{align*}

Schwarz (2009, 2012) suggests that strong determiners denote functions that take an independent situation argument that saturates their restrictor. Thus, strong DP objects do not identify their situation argument with that of the main predicate. Consequently, in a VP like recommend the student, the strong DP object the student does not compose with the verb by Restrict. The DP is an expression of type $e$ and its composition with the verb proceeds by Functional Application, as illustrated below.

\begin{align*}
(48) & \quad \llbracket \text{the} \rrbracket = [\lambda s . \lambda P_{s,t} : \exists ! y (P(y)(s) = 1) . \iota x (P(x)(s) = 1)] \\
(49) & \quad \llbracket [DP \text{ [the } s_1 \text{ ] student}] \rrbracket^\theta = \iota x (x \text{ is a student in } g(1)), \text{ defined iff } \exists ! y (y \text{ is a student in } g(1)) \\
(50) & \quad \llbracket [VP \text{ recommend } [DP \text{ [the } s_1 \text{ ] student}]] \rrbracket^\theta = [\lambda y . \lambda s . y \text{ recommends in } s \iota x (x \text{ is a student in } g(1))]
\end{align*}

In (49), the situation denoted by $s_1$, i.e. $g(1)$, saturates the first argument of the function denoted by the. Consequently, the predicate student is evaluated with respect to $g(1)$.

When a strong DP object is a universal quantifier like every student, it undergoes QR for type reasons creating a $\lambda$-abstract that binds the trace of type $e$. The embedded predicate applies to the trace by Functional Application and so does the raised quantificational DP to its sister.

6. Dependent situations in relative clauses

In the previous section, I showed that what unites weak DP objects and modifiers of fronted verbs is their mode of semantic composition with the verb. This mode of composition involves identification of situation arguments. Weak DP objects and verbal modifiers thus describe the same situation that is described by the main predicate. The picture becomes more complex when we look at the situations described by relative clauses inside weak DP objects.

The first thing to observe is an apparent problem with Keshet’s (2008a) Intersective Predicate Generalization. Consider Keshet’s (2008a) sentence (51).
Every U.S. Senator who was at Harvard in 1964 got straight A’s in college.

Unlike sentence (24) above, (51) is not anomalous. However, this might seem unexpected. Under the common assumption that relative clauses are modifiers of their head nouns, the relative clause who was at Harvard in 1964 is an expression of type <e, <s,t>>:

\[
[\text{who was at Harvard in 1964}] = [\lambda x . \lambda s . x \text{ was in Harvard in } s \text{ and } s \text{ is in } 1964]
\]

When the relative clause composes with a noun like U.S. Senator to create a complex predicate U.S. Senator who was at Harvard in 1964, we should expect the Intersective Predicate Generalization to require that both predicates be evaluated against the same situation. Sentence (51) should then be anomalous just like sentence (24). However, this is not what we observe.

What makes it possible for the relative clause to in (52) to describe a different situation from the situation described by the head NP U.S. Senator in (51) is the presence of the past tense that puts the situation of being at Harvard into the past of the situation of being a U.S. Senator.

An insight into the contribution of tense in relative clauses comes from Kratzer (2007) and Alxatib & Sharvit (2017). Kratzer (2007) suggests that tenses relate situations (a past tense in a simplex sentence relates the topic situation with the utterance situation by the relation of temporal precedence), Alxatib & Sharvit (2017) show that tenses inside English relative clauses can be locally anchored\(^5\). If tenses introduce situations (rather than times), then building on Partee (1973) and Heim (1994) we can understand them as bearing indices that are mapped to contextually relevant situations. Building on Kusliy (2020), I propose that a relative clause like that John taught has the following interpretation:

\[
[\text{that Past}_1 \text{ John taught}]^g = [\lambda x . \lambda s: g(1) < s . \text{ John taught } x \text{ in } g(1)]
\]

In (53), “<” stands for “temporally precedes” and the relative clause is understood to describe situation g(1), which is presupposed to precede the anchoring situation associated with “\(\lambda s\)”.

Under this perspective, the apparent problem with the Intersective Predicate Generalization disappears. A relative clause is a relation between anchoring situations and individuals. When it is intersected with a noun, it identifies its anchoring situation argument with the situation argument of the head noun. The result of such a composition is given in (54):

\[
[[\text{NP student that Past}_1 \text{ John taught}]]^g = [\lambda x . \lambda s: g(1) < s . \text{ x is a student in } s \text{ and John taught } x \text{ in } g(1)]
\]

Observe that the NP in (54) takes a situation argument and this situation is described by student. The situation that is described by the relative clause is different, but it is anchored to the situation of being a student.

\(^5\) I made the same proposal independently and on a different set of facts in my UMass Generals Paper Kusliy (2017) and in Kusliy (2020).
As before, the weak DP *a student that Past₁ John taught* is equivalent to the NP in (54). When this DP composes with a verb like *criticize* by Restrict, its situation argument is identified with that of the verb. The unsaturated internal argument is then closed by Existential Closure:

\[
[[\{VP \exists [VP \text{criticize } [DP a [NP \text{student that Past₁ John taught}]]] \}]^g = \\
[\lambda y. \lambda s: g(1) < s . \exists x (x \text{ is a student in } s \text{ and John taught } x \text{ in } g(1) \text{ and } y \text{ criticizes } x \text{ in } s)]
\]

In (55), the situation described by the relative clause, while being different from that described by the main predicate, remains *semantically dependent* on the main situation in the sense that it is anchored to it and, therefore, co-varies with it.

We thus arrive at a picture according to which situations described by relative clauses inside weak DPs are semantically dependent on the situations described by the main predicates.

The situation described by a relative clause inside a strong DP semantically depends on the restrictor situation denoted the variable taken by a strong determiner as its first argument. It is semantically independent of the situation described by the main predicate.

Thus, when a strong determiner like *the* in (48) composes with the NP *student that John taught* from (54), the resulting DP *the student that John taught* receives the interpretation in (56):

\[
[[DP [the s₂] [NP \text{student that Past₁ John taught}]]]^g = \iota x (x \text{ is a student in } g(2) \text{ and John taught } x \text{ in } g(1)), \\
\text{defined iff } g(1) < g(2), \exists ! y(y \text{ is a student in } g(2) \text{ and John taught } y \text{ in } g(1))
\]

The DP in (56) composes with a verb like *criticize* by Functional Application to create a VP:

\[
[[VP \text{criticize } [DP [the s₂] [NP \text{student that Past₁ John taught}]]]]^g = \\
[\lambda y . \lambda s : y \text{ criticizes in } s \iota x (x \text{ is a student in } g(2) \text{ and John taught } x \text{ in } g(1))] \\
\text{defined iff } g(1) < g(2), \exists ! z (z \text{ is a student in } g(2) \text{ and John taught } z \text{ in } g(1))
\]

We see that the relative clause describes situation \(g(1)\) which does not semantically depend on the situation argument that saturates the whole VP.

7. Dependent situations in complement CPs

In the textbook approach to the semantics of attitude reports which goes back at least to Hintikka (1969), attitude verbs are viewed as taking their complement CPs as arguments. Complement CPs denote propositions and attitude verbs denote functions that introduce quantification over attitude alternatives and require that the proposition denoted by their CP complements obtain in each of those alternatives.

A different perspective on the interaction of an attitude verb with its complement CP is presented in Kratzer (2006). Attitude verbs are viewed as taking an individual as their internal argument. This is supported by their compatibility with DP arguments:
(58) John believes [DP the rumor that ghosts exist].

Kratzer (2006) proposes that attitude verbs take so-called content individuals as their internal arguments and are similar to transitive verbs. These individuals are entities of type e; they represent the content of an attitude. A complement CP is a predicate of content individuals (expression of type <e,t>). TPs denote propositions (type <s,t>). The complementizer that applies to a TP is an expression of type <<s,t>,<e,t>>. The complementizer introduces universal quantification over alternatives compatible with the content individual and requires that the proposition denoted by the TP obtain in all of those alternatives (see Moulton 2009).

Importantly, Kratzer (2006) explicitly proposes that a complement CP composes with an attitude verb by a version of Restrict. The semantics of an attitude verb like believe can be represented as shown in (59), where the first argument of the verb is its content argument and the second argument is its individual argument saturated by the subject.

(59) \[\lambda c . \lambda x . e . \lambda s . x \text{ believes } c \text{ in } s\]

For a CP like that ghosts exist, Kratzer (2006) proposes the following interpretation:

(60) \[\lambda c . \forall w'(\text{compatible}(w')(c) \rightarrow \text{ghosts exist in } w')\]

According to Kratzer, when the CP composes with the verb to produce the VP believe that ghosts exist, it restricts the content argument of the verb. The content argument of the CP and the content argument of the attitude verb are identified:

(61) \[\lambda c . \lambda x . e . \lambda s . x \text{ believes } c \text{ in } s \text{ and } \forall w'(\text{compatible}(w')(c) \rightarrow \text{ghosts exist in } w')\]

Kratzer (2006) also proposes that the unsaturated content argument on the resulting VP is closed by Existential Closure. The resulting structure of the VP after Existential Closure has applied is as shown in (62) and its interpretation is given in (63):

(62) \[\forall p_2 \exists [\forall p_1 \text{ believe [CP that ghosts exist]}]\]

(63) \[\lambda x . \lambda s . \exists c (x \text{ believes } c \text{ in } s \text{ and } \forall w'(\text{compatible}(w')(c) \rightarrow \text{ghosts exist in } w'))\]

In order for parallelism between complement CPs and weak DP objects to be fully established, CPs must also take a situation argument and identify it with the situation argument of the attitude verb when they compose by Restrict.

In Kusliy (2020), I provide new evidence and arguments suggesting that this is indeed the case. Just like weak DP objects, complement CPs can be viewed as describing an actual situation anchored to the situation described by the main verb. This happens when the main tense of a complement CP is interpreted de re and is locally anchored. This means the embedded de re tense is anchored to the situation argument of the main verb just like the tense inside a relative clause embedded in a weak DP object anchors to the situation argument of the main verb (see (55) above). I argue that the locally anchored temporal de re analysis is the preferred one for attitude reports in English.
However, the semantics of attitude reports involves the intensional component. In order to account for it within a theory of a locally anchored *de re* tense, a technically complex formal apparatus is required. I provide this apparatus in Kusliy (2020), but space limitations prevent me from presenting it here in full form. So, I can only outline that approach here in a significantly impoverished way.

Recall sentence (13), repeated here as (64):

(64) *Think that Mary$_1$ arrived on time, she$_1$ did.

The approach builds on Kratzer’s (2006) treatment of CP complementation and extends it to cases of the temporal *de re*. In a nutshell, it is proposed that complement CPs like *that Mary arrived on time* has the following interpretation:

(65) \[ \langle \text{that Past$_1$ Mary arrived on time} \rangle = [\lambda c . \lambda s: g(1) < s . c \text{ is a content individual and that Mary arrived on time in } g(1) \text{ is the content of } c] \]

Observe that in (65), unlike (60), the contribution of the past tense is accounted for. As before, the past tense introduces a situation, here $g(1)$, and anchors to a situation that the CP takes as argument. The CP now becomes a relation between content individuals and temporal anchors$^6$. When the CP composes with the attitude verb by Restrict as suggested by Kratzer (2006), it identifies both its content individual and its situation arguments with the corresponding arguments of the attitude verb. The situation described by the complement CP thus becomes semantically dependent on the situation described by the matrix verb.

8. Semantic dependence on the Austinian situation and Condition C effects

In the preceding discussion, I observed that adjuncts, weak DP objects and CP complements to fronted verbs compose with these verbs by Restrict and identify their situation arguments with the situation argument of the verb. Situations described by adjuncts are identical to those described by verbs. Situations described by relative clauses inside weak DP objects or CP complements to fronted verbs are semantically dependent on the situation described by the main predicate. I also observed that this is not what happens in the case of strong DP objects whose restrictors are evaluated against an independent situation that is not identified with the situation described by the main predicate. In this section, I propose a hypothesis why this distinction matters for Condition C effects.

I invoke the notion of Austinian topic situations. They are contextually provided situations that particular utterances are about (Barwise & Echmendy, 1987; Kratzer, 2007). An Austinian situation is the situation that the assertive content of an utterance is about. These situations are described by the main predicate of a sentence. Thus, to be semantically dependent on the situation described by the main predicate of an uttered sentence means to be semantically dependent on the Austinian situation.

$^6$ In a more detailed version of this theory, the situation denoted by the embedded *de re* past tense is mapped to a concept by a concept generator (see Kusliy 2020).
We saw that adjuncts, weak DP objects and CP complements to fronted verbs describe situations that are identical to or semantically dependent on the situation described by the main verb. We also saw that they are the environments in which Conditions C effects are triggered. In light of all this, I propose the following descriptive generalization:

(66) If a potential Condition C trigger inside a fronted constituent is argument to a predicate that describes a situation that is identical or semantically dependent on the Austinian situation of the whole sentence, then the Condition C effect cannot be obviated.

The general rationale behind (66) is the following: when a fronted VP reconstructs into its base position, only those of its components that are related to the Austinian situation retain their prominence and are visible for Condition C. The components that relate to the situations that are not dependent on the Austinian situation are demoted and are not seen by Condition C after the VP reconstructs.

Let us see how (66) relates to the cases that constitute Heycock’s puzzle. First, recall the simple extensional cases from (15)a,b, repeated below:

(67) a. *Criticize a student that Past3 John1 recommended, he1 do+Past2.
b. Criticize the student that Past1 John1 recommended, he1 do+Past3.

For the purposes of this discussion, I assume that the matrix tense provides the Austinian topic situation\(^7\), which feeds the situation argument on the fronted VP. The fronted VP in (67)a has the semantics in (68): the weak DP object composes with the verb by Restrict followed by the Existential Closure of the internal argument of the verb. The result is (68):

(68) \[
\begin{array}{c}
\text{[[VP} \exists \text{ [DP a\text{weak student [that Past3 John1 taught]]}]]]
\\= \[
\lambda x . \lambda s : \lambda y (y \text{ is a student in } s \text{ and John taught } y \text{ in } g(3) \text{ and } x \text{ criticizes } y \text{ in } s )
\end{array}
\]

After the VP reconstructs, its external individual and its situation arguments are saturated by the matrix subject he1 (the index on the pronoun is mapped to John by the assignment function) and by the matrix tense (Past2), respectively. The truth conditions for (67)a are below:

(69) \[
\begin{array}{c}
\text{[[(67)a]]}^t = 1 \iff \exists y (y \text{ is a student in } g(2) \text{ and John taught } y \text{ in } g(3) \text{ and } x \text{ criticizes } y \text{ in } s )
\end{array}
\]

In (69), the embedded situation g(3) is anchored to g(2) by the embedded tense and is, therefore, semantically dependent on it. By (66), Condition C applies and the sentence is ruled out.

The semantics for the fronted VP in (67)b is provided in (57) above and the truth conditions for this sentence are given below:

\(^7\) This is not exactly true because the Austinian topic situation is the situation described by the main predicate and viewpoint aspect establishes a relation between this situation and the situation provided by the main tense (Klein, 1994; Kratzer 2007) making the former semantically dependent on the latter. I will ignore this complication here because it does not seem to bear on anything I have to say.
(70) \[ (67)b]^{\mathcal{E}} = 1 \text{ iff } \exists x (x \text{ is a student in } g(2) \text{ and John taught } x \text{ in } g(1)), \text{ defined iff } g(3) < t \text{ and } g(1) < g(2), \exists ! z (z \text{ is a student in } g(2) \text{ and John taught } z \text{ in } g(1)) \]

According to (70), the situation described by the relative clause, namely \( g(1) \), is semantically independent of the Austinian situation \( g(3) \). \( g(1) \) is dependent on \( g(2) \), which is the contextually salient situation provided by the situation argument taken by the strong determiner.

The more complicated sentences from (5) and (6) receive a similar treatment modulo the intensional component of attitude reports (not fully accounted for in this exposition):

(71) *Recommend a student that Past\(_3\) John\(_1\) taught, Past\(_4\) he\(_1\) said Mary do+Past\(_2\).
(72) Recommend [[the s\(_2\)] student that Past\(_4\) John\(_1\) taught], Past\(_3\) he\(_1\) said Mary do+Past\(_3\).

The truth conditions for (71) are given in (73):

(73) \[ (71)^{\mathcal{E}} = 1 \text{ iff } \exists c (\text{John said } c \text{ in } g(4) \text{ and in all alternatives compatible with } c, \text{ it is the case that } \exists y (y \text{ is a student and John taught } y \text{ in } g(3) \text{ and Mary recommended } y \text{ in } g(2)), \text{ defined iff } g(4) < t, g(2) < g(4), g(3) < g(2) \]

The Austinian topic situation is \( g(4) \) and the situation described by the relative clause, namely \( g(3) \), is semantically dependent on \( g(4) \), because it is presupposed to precede \( g(2) \), which is presupposed to precede \( g(4) \). The configuration described in (66) obtains and (71) is ruled out.

The truth conditions for (72) are given in (74):

(74) \[ (72)^{\mathcal{E}} = 1 \text{ iff } \exists c (\text{John said } c \text{ in } g(5) \text{ and in all alternatives compatible with } c, \text{ it is the case that Mary recommends in } g(3) \text{ ty}(y \text{ is a student in } g(2) \text{ and John taught } y \text{ in } g(4)), \text{ defined iff } g(5) < t, g(3) < g(5), g(4) < g(2), \exists ! y (y \text{ is a student in } g(2) \text{ and John taught } y \text{ in } g(4)) \]

In (74), the Austinian topic situation is \( g(5) \). The situation provided by the main tense of the complement CP is \( g(3) \), which is semantically dependent on \( g(5) \). The situation described by the relative clause, namely \( g(4) \), precedes the restrictor situation \( g(2) \). Neither \( g(4) \), nor \( g(2) \) are semantically dependent on the Austinian situation. The configuration described in (66) does not obtain and the Condition C effect is (72) is not triggered.

The Condition C effect is triggered in sentence (13)/(64) repeated again in (75), as seen from the schematic truth conditions given in (76):

(75) *Think that Past\(_3\) Mary\(_1\) arrived on time, she\(_1\) do+Past\(_2\).
(76) \[ (75)^{\mathcal{E}} = 1 \text{ iff } \exists c (\text{Mary thought } c \text{ in } g(2) \text{ and in all alternatives compatible with } c, \text{ it is the case that Mary arrived on time in } g(3), \text{ defined iff } g(2) < t, g(3) < g(2) \]
The situation described by the embedded clause, \(g(3)\), is semantically dependent on the Austinian topic situation \(g(2)\). The predicate that describes that situation takes the potential Condition C trigger as argument. By (66), the disjoint reference effect is triggered in (75).

Finally, sentence (18)b, repeated below as (77), also triggers the Condition C effect.

\[(77)\quad *\text{Sit next to John}_1, \text{Past}_2 \text{ he}_3 \text{ said Mary do+Past}_3.\]

\[(78)\quad \llbracket(77)\rrbracket^g_t = 1 \iff \exists c(\text{John said c in g(2) and in all alternatives compatible with c, it is the case that Mary sat next to John in g(3)}), \text{defined iff g(2)<t, g(3)<g(2)}\]

The situation described by the adjunct of the fronted verb is identical to the situation described by the main predicate of the complement CP and since the latter is semantically dependent on the Austinian topic situation, the former is too. Since the potential Condition C trigger John is argument to the predicate next to, which describes the Austinian topic situation, the configuration described in (66) obtains and the Condition C effect is triggered.

9. Conclusion and outlook

In this paper, I presented and explored a puzzle about Condition C effects in fronted VPs. I observed that the disjoint reference effect between a proper name inside a fronted VP and a matrix pronoun is obviated only if the proper name is embedded in a strong DP. Proper names in object positions and inside adjuncts, complement CPs and weak DP objects all trigger the Condition C effect. I showed that a number of current structural, semantic and hybrid accounts of Condition C effects cannot capture the data. I observed that the emergence of Condition C effects correlates with the availability of a particular mode of semantic composition between a fronted verb and its complement or adjunct. I invoked the approach of situation semantics and proposed that Condition C effects arise when a proper name occurs inside a clause that describes a situation that is semantically dependent on the Austinian topic situation described by the assertive content of the whole sentence. I showed how this view applies to cases considered in this paper.

This discussion provides an answer to Question 1 in Section 3 about the nature of the contrast between strong and weak DPs and its relation to Condition C effects. It also provides a partial answer to Question 2 about the nature of the pattern observed between weak DP objects and complement CPs: the latter are presented as describing a situation that is semantically dependent on the situation described by the attitude verb.

Having proposed a distinction between those VP fronting constructions that trigger Condition C effects and those that do not, I did not say anything about the reason why similar contrasts are not observed in non-fronting constructions. Because of space limitations, Question 3 must remain unanswered here. I am leaving its discussion for a future occasion.

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Extent scales are licensed by atomic Incremental Theme objects: evidence from begin DP

Arkadiusz KWAPISZEWSKI — University of Oxford

Abstract. Dynamic event predicates denote ordered change in some scalar property corresponding to the theme participant. In particular, Change of State predicates map onto property scales (e.g. TEMPERATURE), while Incremental Theme predicates are measured out by the extent of their objects. In terms of VP composition, Rappaport Hovav (2008) proposes that property scales are hard-wired into the lexical semantics of verbs (e.g. heat), whereas extent scales are licensed by Incremental Theme objects. In this paper, I provide new evidence for this hypothesis. The relevant data come from VPs like begin the book, which have only an under-specified Incremental Theme reading. I then turn to examples like begin eight films, which are obligatorily distributive. I use this fact to argue for an even stronger hypothesis: extent scales are licensed by atomic Incremental Themes.

Keywords: scalarity, event structure, lexical semantics, incremental theme predicates, aspectual verbs, complement coercion, partitivity, distributivity.

1. Introduction

On the degree-based approach to event structure, event predicates denote ordered change in the value of some scalar attribute (e.g. extent, temperature, location) associated with the theme participant (Hay et al., 1999; Kennedy and McNally, 1999; Kennedy and Levin, 2002, 2008). For instance, the event of painting in (1a) is measured out by the surface area of the wall, the event of cooling in (2a) is homomorphic to the decrease in the temperature of the water, and the event of driving in (3a) is delimited by the progress of the ambulance across the bridge. More generally, Incremental Theme predicates map onto the extent of their theme, Change of State predicates involve property scales such as HEAT or WIDTH, while Path of Motion predicates track the location of some entity on a directed path. By allowing different predicate classes to map onto different scalar attributes, the scalar approach gives us a unified semantics for the VPs in (1)-(3) below.

(1) a. Sarah painted the wall in her living room.
   b. Patrick ate a pizza.

(2) a. The water cooled from 20 °C to 10 °C.
   b. The construction workers widened the road.

(3) a. The ambulance drove across the bridge.
   b. Mary pushed the cart to the supermarket.

I assume that every scalar VP must identify a scalar attribute to be interpreted. However, this still leaves open the question of where this scalar attribute comes from. What is the source of scalarity in VP composition? Which elements introduce extent, property and path scales into

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the semantics of complex VPs? Consider the simplest branching VP structure consisting of a verb and its complement. A structure like that presents us with two options: the scalar attribute can be encoded on the lexical head V or on the verbal complement DP. These alternatives are illustrated in (4a) and (4b), respectively.

(4) The Source of the Scalar Attribute (SA) in VP Composition

a. 

\[
\begin{array}{c}
\text{VP} \\
\quad \text{[SA]} \\
\quad \downarrow \\
\quad V \\
\quad \text{DP} \\
\quad \text{[SA]}
\end{array}
\]

b. 

\[
\begin{array}{c}
\text{VP} \\
\quad \text{[SA]} \\
\quad \downarrow \\
\quad V \\
\quad \text{DP} \\
\quad \text{[SA]}
\end{array}
\]

The purpose of the present work is to defend and extend the hypothesis put forward in Rappaport Hovav (2008), according to which Change of State predicates are composed in accordance with (4a), while Incremental Theme predicates are assigned the semantic representation in (4b). This is to say that property scales, as well as certain other scales which do not measure the extent of the theme, are hard-wired into the lexical semantics of specific verbs, e.g. cool → TEMPERATURE, widen → WIDTH, ascend → ALTITUDE. In contrast, Incremental Theme verbs (paint, eat) are devoid of any scalar properties. It is only Incremental Theme objects (the wall, a pizza) which contribute extent scales to the VP as a whole.

The current evidence for this position is threefold. Firstly, Change of State verbs are incompatible with resultative XPs that introduce their own scales (5a), whereas Incremental Theme verbs co-occur with all manner of resultative XPs (5b). Assuming a one-scale-per-VP constraint, this suggests that Incremental Theme verbs do not lexicalize any scales of their own. Secondly, verbs like dim and cool resist object drop (6a), while scrub, read and eat have unergative uses (6b). This can be explained if the presence of a scalar attribute requires the overt realization of the argument bearing that attribute. Finally, degree phrases take the form of VP-level modifiers in Change of State predicates (7a), but they appear as DP-internal modifiers in Incremental Theme predicates (7b)-(7c). This again points to the DP as the structural source of the extent scale.

(5) a. ??We dimmed / cooled / cleared the room empty.
   b. We steamed the clothes dry / clean / stiff.

(6) a. All last night we dimmed *(the lights) / cooled *(the room).
   b. All last night Cinderella scrubbed / read / ate.

   (adapted from Rappaport Hovav, 2008)

(7) a. She warmed the soup more than he did / too much / ten degrees
   b. ??Jones wrote the paper more / too much / two sections.
   c. Jones wrote more / too much / two sections of the paper.

   (adapted from Gawron, 2007, cited in Kennedy, 2012)

\footnote{Path of Motion VPs inherit their scalar attribute from goal/path PPs. Since my focus is on the properties of Incremental Theme objects, I set Path of Motion predicates aside for the rest of this paper.}
In this paper, I provide new evidence for Rappaport Hovav’s (2008) hypothesis that extent scales originate on Incremental Theme objects (see also Levin and Rappaport Hovav, 2010, as well as Rappaport Hovav, 2014). The relevant data come from the interpretation of aspectual verbs with DP complements, e.g. *begin/finish the book*. In Section 2, I show that the *begin DP* construction licenses extent scales to the exclusion of any other scalar attributes. Given the absence of a lexical verb in this VP, this is exactly what (8) predicts. A compositional analysis of this construction is provided in Section 3.

(8) Extent scales are licensed by Incremental Theme objects.

In Section 5, I make an even stronger claim: extent scales are computed on *atomic* Incremental Theme objects. I argue that this assumption is necessary to account for the obligatory distributivity of VPs such as *begin eight films*. After presenting a formal analysis of these cases in Section 6, I mention two other puzzles from English and Hindi that find a natural explanation if the strong version of Rappaport Hovav’s (2008) hypothesis is adopted.

(9) Extent scales are licensed by *atomic* Incremental Theme objects.

2. Evidence from *Begin DP*

Most aspectual verbs, including *begin, start, finish* and *continue*, can be used with either DP or VP complements (10). Since the core function of these verbs is to map an event onto its initial, medial or final stage, most researchers consider the VP variant to be the primary one (Pustejovsky, 1991; 1993; Egg, 2003; Pylkkänen and McElree, 2006; but see Piñango and Deo, 2016, and the discussion in Section 4 for a different view). This creates the problem of how to derive the DP variant compositionally. Assuming that aspectual verbs have a constant denotation across their DP- and VP-related uses, what licenses the inference to an event of reading or writing in the absence of a lexical verb in (10a)?

(10) a. Patrick began [*DP the book*].
    b. Patrick began [*VP to read/write the book*].
    c. Patrick began [*VP reading/writing the book*].

While lexical semantics and pragmatics certainly play a role in the interpretation of *begin DP*, it is not the case that sentences like (10a) can refer to any type of event whatsoever. Rather, the possible readings of *begin DP* are subject to the following semantic constraint:

(11) The denotation of *begin DP* is constrained to events which can be mapped onto an extent scale (i.e. underspecified Incremental Theme events).

Starting with the Incremental Theme predicates in (12), we observe that any incremental event described by *begin VP* can also be described by *begin DP*. Thus, *begin mowing the lawn* and *begin the lawn* can be used interchangeably in the context of someone mowing the lawn (12a). The other examples in (12) work in a parallel way. The sentence in (12f) is particularly interesting, as it suggests that the line between Incremental Theme and Change of State predicates is not always clear-cut. An event of cleaning the kitchen can be conceptualized in different ways:

\[\text{[reading the book]}\]
\[\text{[eating the book]}\]

3Of course, *reading* and *writing* are not the only interpretive options in (10a). Given a sufficiently rich context, *begin the book* can also be interpreted as referring to the process of *editing, scanning* or even *eating the book*. For this last example, imagine that Patrick is the name of a particularly ravenous goat. See Lascarides and Copestake 1998 for a pragmatically-oriented approach to these data.
ways depending on the underlying scale: if we opt for the CLEANLINESS scale, the kitchen as a whole gradually shifts from being dirty to being clean; the use of the extent scale, in turn, implies that the kitchen area becomes incrementally affected by the action of cleaning. By hypothesis, begin DP can refer to any event which has an extent-based conceptualization; the existence of alternative conceptualizations is irrelevant for the generalization in (11).

(12) INCREMENTAL THEME PREDICATES
   a. The gardener began (mowing) the lawn.
   b. A broom in hand, the caretaker began (sweeping) the corridor.
   c. The graduate student began (preparing) her handout.
   d. The library printer finished (printing) my thesis in five minutes.
   e. The hikers finished (walking) the Appalachian trial.
   f. The couple finished (cleaning) the kitchen.

Moving on to the Change of State predicates in (13), we see that they cannot be described using the begin DP construction. This remains true even when the context is rich enough to license an inference to warming, dimming, etc. Crucially, all of these events map onto property scales such as TEMPERATURE or BRIGHTNESS. Furthermore, they cannot be reconceptualized as involving extent scales, since the progress of safe-unlocking or spotlight-dimming is not measurable by the physical extent of the safe or the spotlight, respectively. I conclude that the use of begin DP is restricted to Incremental Theme predicates, as hypothesized in (11). This conclusion is further confirmed by the infelicity of the examples in (14) with the lexical verb omitted. Verbs like cross, surround and saddle lexicalize complex path scales, so it is not surprising that they cannot be left out in the begin/finish DP construction, which is only compatible with simple extent scales.

(13) NON-INCREMENTAL CHANGE OF STATE PREDICATES
   a. John began ??(warming) his hands by rubbing them together.
   b. Blowing hot air on it, the boys began ??(melting) an ice cube.
   c. It was getting dark outside, so Mary began ??(lowering) the blinds.
   d. At the petrol station, Patrick finished ??(refilling) his car.
   e. Rotating the dial twice, the burglar finished ??(unlocking) the safe.
   f. As the curtain fell, the technician finished ??(dimming) the spotlight.

(14) PREDICATES INVOLVING COMPLEX SPATIAL SCALES
   a. Setting off from Spain, Columbus began ??(crossing) the ocean.
   b. Chased by a dog, the postman began ??(climbing) a tall fence.
   c. When the pigeons returned, the child began ??(scattering) the seeds.
   d. The siege began when the army finished ??(surrounding) the city.
   e. Before she mounted it, Angela finished ??(saddling) her horse.
   f. The hikers will finish ??(traversing) the country by early August.

The pattern of data in (12)-(14) is fully consistent with the hypothesis that extent scales are licensed by Incremental Theme objects, while property scales and complex spatial scales are lexically encoded on individual verbs. Specifically, I assume that the structure of begin DP is along the lines of (15a), with begin merged in the position of the main verb. I further assume that aspectual verbs do not lexicalize any scales, but that a VP headed by begin or finish needs to identify a scalar attribute to be interpreted. Logically, this leaves us with only one
option: the scalar attribute must be introduced by the DP complement. Following Rappaport Hovav (2008), the only scales licensed by DP complements are extent scales, thus deriving the semantic constraint in (11).

(15)  **An Aspectual Verb with a Complement DP (left) and VP (right)**

![Diagram]

As for the structure of *begin VP*, I assume that *begin* occupies an aspectual projection above the VP. The VP-external position of aspectual verbs allows them to map entire event predicates onto their initial, medial or final stages. For more on the syntax of aspectual verbs, particularly with respect to their status as raising/control verbs, see Perlmutter (1970), Fukuda (2008) and references therein.

3. **Formal Analysis: Part I**

This section turns to the compositional analysis of *begin/finish DP*. I assume a semantic ontology containing objects (type $e$), events (type $s$), degrees (type $d$) and time intervals (type $i$). The domains of objects and events are organized into semi-lattice structures by the operation of sum formation $\sqcup$ and the subpart relation $\sqsubseteq$ (Bach, 1986; Landman, 2000; Champollion and Krifka, 2016). The domain of events is further ordered by the temporal precedence relation $\ll$. Moreover, I assume that all objects can be divided into ‘things’ and ‘matter’, with things related to their material substance by the material subpart relation $\sqsubseteq_m$ (Link, 1983). The material subpart relation will be used in Section 6 to measure the amount of ‘stuff’ that makes up atomic Incremental Theme objects. Finally, for the sake of simplicity, I treat degrees as points on a scale from 0 to 1, though see Kennedy (2001) and Kennedy and McNally (2005) for a more elaborate treatment in terms of positive and negative intervals.

My analysis of *begin DP* builds on Kennedy (2012) and Bochnak (2013) by presupposing the existence of a partitive Incremental Theme morpheme $\text{PART}_{inc}$. As shown in (16a)-(16b), this functional morpheme merges with the direct object in the syntax. Though often phonologically null, $\text{PART}_{inc}$ can also be realized overtly as the measure word *of* in e.g. *eat half of the sandwich*. In terms of its semantic contribution, $\text{PART}_{inc}$ maps an object $x$ onto a gradable predicate of events (type $\langle d, s \rangle$). It does so by introducing a measure-of-change function $\text{part}_\Delta$, which measures how much of $x$ participates in the event $e$.$^4$ In a typical Incremental Theme event, the proportion of $x$ involved in the event increases monotonically as the event progresses in time. Together with Kennedy (2012) and Bochnak (2013), I propose that the measure-of-change function $\text{part}_\Delta$ is the formal device responsible for introducing extent scales into the semantic representation of Incremental Theme predicates.

(16)  a.  $[\text{PART}_{inc}] = \lambda x \lambda y \lambda d \lambda e \text{part}_\Delta(x)(y)(e) = d$

$^4$In the definition of $\text{PART}_{inc}$, the object variable $y$ represents the subpart of $x$ which participates in $e$. 

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b. \([\text{PART}_{\text{inc}} \text{ the book}] = \lambda d \lambda e. \exists y [\text{part}_\Delta(\text{book})(y)(e) = d]\)

c. \([\text{read PART}_{\text{inc}} \text{ the book}]_{\text{telic}} = \lambda e. \exists d, y [\text{read}(e) \land \text{part}_\Delta(\text{book})(y)(e) = d \land d = 1]\)

d. \([\text{read PART}_{\text{inc}} \text{ the book}]_{\text{atelic}} = \lambda e. \exists d, y [\text{read}(e) \land \text{part}_\Delta(\text{book})(y)(e) = d \land d > 0]\)

The existence of \(\text{PART}_{\text{inc}}\) leads us to a fully Neo-Davidsonian representation of Incremental Theme predicates, with the object severed from the verb. In (16c)-(16d), the verb \text{read} denotes a simple property of events (type \(\langle s, t \rangle\)). It combines with \text{the book} via a simple rule of Predicate Conjunction (Kratzer, 1996). Note that, without any further specification, the degree argument can be set either to the maximal value, entailing that the entire book was read, or to the minimal one, entailing only that some book-reading activity has taken place. This difference corresponds to the telic and the atelic construal of \text{read the book}, respectively.

What about the composition of \text{begin the book}? The original analysis of this construction assumes that the combination of an event-selecting asp ectual verb with an object-denoting DP results in a type clash. This type clash can only be repaired by a special lexical or semantic mechanism, e.g. one retrieving the predicate \text{read} or \text{write} from the complex lexical entry of \text{book} (Pustejovsky, 1991, 1993).

The adoption of \(\text{PART}_{\text{inc}}\) allows for an alternative analysis of \text{begin the book}, which does not involve a type clash followed by the application of a repair mechanism. Specifically, I assume that the semantic composition of \text{begin} and \text{the book} is mediated by \(\text{PART}_{\text{inc}}\). The result of applying \(\text{PART}_{\text{inc}}\) to \text{the book} is a gradable predicate of events, as in (16b) above. After the contextual binding of the degree argument, we end up with a predicate of events whose denotation can be paraphrased as \textit{to incrementally affect the extent of the book in some unspecified manner}. It is this event predicate which serves as an input to the aspectual verb \text{begin}, on the well-motivated assumption that aspectual verbs take event predicates as arguments (Piñón, 1997). The semantic derivation of \text{begin the book} is illustrated directly below.

\[(17) \ [\text{begin PART}_{\text{inc}} \text{ the book}] = [\text{begin}([\text{PART}_{\text{inc}} \text{ the book}])] = \text{begin}(\lambda e. \exists d, y [\text{part}_\Delta(\text{bk})(y)(e) = d \land d > 0])\]

For concreteness, I formalize the denotation of aspectual verbs as in (18), with \(\sqsubseteq_{\text{init}}\) and \(\sqsubseteq_{\text{fin}}\) denoting the initial/final subevent relation, \(\ll\) standing for temporal precedence and \(\sqcup\) for the operation of sum formation. The final conjunct is required to ensure that there can be no crying going on before \text{Adam began to cry} and no drawing of a circle after \text{Victoria finished drawing a circle}. In other words, initial and final boundaries are defined relative to an event description \(P\). For more details on the semantics of aspectual verbs and on boundary events in general, see the excellent analysis in Piñón (1997).

\[(18) \begin{align*}
\text{begin} &= \lambda P \lambda e. \exists e' \exists e'' [\text{e}\sqsubseteq_{\text{init}} e' \land P(e') \land \forall e'' [e'' \ll e' \rightarrow \neg P(e' \sqcup e'')]] \\
\text{finish} &= \lambda P \lambda e. \exists e' \exists e'' [\text{e}\sqsubseteq_{\text{fin}} e' \land P(e') \land \forall e'' [e'' \ll e' \rightarrow \neg P(e' \sqcup e'')]]
\end{align*}\]

An event \(e\) such that \(e\) is the initial/final part of some \(P\)-event \(e'\) and there is no earlier/later event \(e''\) which extends \(e'\) into a larger \(P\)-event

Overall, the analysis presented in this section provides further support for the existence of \(\text{PART}_{\text{inc}}\), a functional morpheme merging with the direct object and introducing extent scales...
into the semantics of complex VPs. The specific properties of \( \text{PART}_{\text{inc}} \) not only account for the restriction of \( \text{begin DP} \) to Incremental Theme events, but they also allow us to compute the meaning of this structure compositionally, with no need to invoke a type clash and subsequent repair.

4. Comparison with Piñango and Deo (2016)

Before moving on to the atomicity constraint on \( \text{PART}_{\text{inc}} \), let me discuss briefly an alternative analysis of the \( \text{begin DP} \) construction. The account presented in Piñango and Deo (2016) also predicts the restriction of \( \text{begin DP} \) to underspecified Incremental Theme predicates. However, it does so by relying on a very different set of assumptions. Most importantly, Piñango and Deo (2016) take the non-agentive, ‘ordering’ use of aspectual verbs to be the basic one:

\[
\begin{align*}
(19) & \quad \text{a. This chapter begins the book.} & \quad f_{\text{identity}}(\text{chap}) \sqsubseteq \text{init } f_{\text{content}}(\text{book}) \\
& \quad \text{b. A thunderstorm began the morning.} & \quad f_{\text{time}}(\text{thu}) \sqsubseteq \text{init } f_{\text{identity}}(\text{morn}) \\
& \quad \text{c. This valley ends the famous trail.} & \quad f_{\text{space}}(\text{valley}) \sqsubseteq \text{fin } f_{\text{space}}(\text{trail})
\end{align*}
\]

Glossing over the formal details, the main idea is that aspectual verbs take two arguments \( x \) and \( y \), and situate \( x \) at the beginning or end of an axis homomorphic to the part structure of \( y \). An axis is a one-dimensional directed path structure in any ontological domain, e.g. informational content in (19a), temporal traces in (19b) and spatial intervals in (19c) (Krifka, 1998).

In order to extend this analysis to the agentive \( \text{begin DP} \) construction in (20a), Piñango and Deo (2016) propose that the theme participant \( \text{the book} \) is mapped onto an event \( e \) by the inverse thematic function \( f_{\text{th}} \). Since \( e \) is required to be an axis, homomorphic to the part structure of \( \text{the book} \), it follows that \( e \) must be an Incremental Theme event. At the same time, the agent participant \( \text{John} \) is mapped onto another event \( e' \) by the inverse thematic function \( f_{\text{ag}} \). The event \( e' \) is then ordered at the beginning of \( e \). The \( \text{begin VP} \) construction in (20b) receives a similar analysis, except that the axial event \( e \) is contributed directly by the VP.

\[
\begin{align*}
(20) & \quad \text{a. John began the book.} & \quad f_{\text{ag}}(\text{John}) \sqsubseteq \text{init } f_{\text{th}}(\text{book}) \\
& \quad \text{b. John began reading the book.} & \quad f_{\text{ag}}(\text{John}) \sqsubseteq \text{init } f_{\text{identity}}(e)
\end{align*}
\]

While I see no problems with Piñango and Deo’s (2016) approach to the non-agentive examples in (19), its extension to (20) suffers from serious drawbacks. There are at least two reasons to think that (19) and (20) should not be given a unified analysis.\(^5\) Firstly, the non-agentive constructions have intransitive variants with PP complements (21a), while the agentive ones do not participate in such an alternation (21b). Secondly, in many languages other than English, only the intransitive variant of the non-agentive \( \text{begin/finish} \) is attested, cf. the German data in (22a)-(22b). At the same time, the agentive \( \text{begin/finish} \) construction in German work just like in English (22c). This suggests the agentive and the non-agentive uses of aspectual verbs should be analyzed independently.

\[
\begin{align*}
(21) & \quad \text{a. This book begins with an interesting chapter.} \\
& \quad \text{b. The book began with John.}
\end{align*}
\]

\[
\begin{align*}
(22) & \quad \text{a. Dieses Buch beginnt mit einem interessanten Kapitel.} & \quad \text{this book.NOM begins with an interesting chapter.DAT}
\end{align*}
\]

\(^5\)Thanks to Matt Husband (p.c.) for pointing out these facts to me.
an interesting chapter.NOM begins this book.ACC

c. Franz begann dieses Buch am Abend (zu lesen).
Franz.NOM began this book.ACC on evening to read

What is more, the semantics assigned to begin/finish VP by Piñango and Deo (2016) do not capture the meaning of aspectual verbs correctly. As shown in (20b), they assume that VPs denote events rather than event predicates, and that aspectual verbs apply to these events directly. To see that this approach makes the wrong predictions, consider an event \(e\) of John running from 1pm to 3pm. This event comprises two subevents \(e_1\) and \(e_2\), such that \(e_1\) involves John running from 1pm to 2pm, while \(e_2\) is the event of John running from 2pm to 3pm. In theory, begin should be able to apply to \(e_2\) to yield the initial stage of John running from 2pm to 3pm. However, the sentence At 2pm, John began running comes out as false in this scenario due to the existence of the previous running event \(e_1\). The upshot of this discussion is that the denotation of aspectual verbs must be relativized to the event description provided by the VP (Piñón, 1997). Aspectual verbs cannot apply to events directly. Unlike Piñango and Deo’s (2016) account, the current proposal is compatible with aspectual verbs taking event predicates as arguments, as evidenced by the lexical entries for begin and finish in (18).

In light of the dissociation between the agentive and non-agentive uses of begin/finish, as well as the requirement that aspectual verbs apply to event predicates, I conclude that the the PART\(_{inc}\)-based proposal is to be preferred over that of Piñango and Deo (2016). While both accounts explain the restriction of begin DP to underspecified Incremental Theme predicates, the present one does not suffer from the empirical and theoretical drawbacks surveyed above.

5. Evidence from Obligatory Distributivity

In the final part of this paper, I argue that extent scales are computed on atomic objects. The relevant hypothesis is repeated directly below.

\[(9) \quad \text{Extent scales are licensed by atomic Incremental Theme objects.}\]

The evidence for (9) comes from obligatory distributive readings of begin and finish with quantified DP complements. The examples in (23)-(24) are constructed on the basis of Egg (2003), who first observed the asymmetry between begin DP and begin VP in the context of strong quantifiers. For context, assume that Max had made a New Year’s resolution to read the collected plays of Shakespeare.

\[(23) \quad \text{On January 1st, Max began every play by Shakespeare}\]
\[a. \quad \text{For every play, Max began to read it} \quad (\forall > \text{begin})\]
\[b. \quad *\text{The plural event of Max reading every play began} \quad (*\text{begin} > \forall)\]

\[(24) \quad \text{On January 1st, Max began reading every play by Shakespeare}\]
\[a. \quad \text{For every play, Max began to read it} \quad (\forall > \text{begin})\]
\[b. \quad \text{The complex event of Max reading every play began} \quad (\text{begin} > \forall)\]

It appears that begin DP and begin VP do not have the same truth-conditions. While the distributive reading is available in both variants, only begin VP can pick out the beginning of a complex event of Max reading every play. Specifically, in a scenario in which Max managed to read only a few pages of Hamlet before falling asleep, Max began every play comes out as
false, while Max began reading every play can be true, provided that Max intends to read all of
the plays in the future.

Egg (2003) explains this asymmetry as an effect of Quantifier Raising, which obligatorily ap-
plies to the DP every play (May, 1985). In the begin DP variant, the quantified DP applies to the
main verb begin, thus invariably outscoping the latter. The begin VP structure admits more
possibilities: every play may raise all the way to AspP, taking scope over begin, or it may
raise only to the edge of the VP, scoping below the aspectual verb. In this way, the relative
scope of begin is syntactically constrained by its VP-internal vs. VP-external position, in ac-
cordance with the standard generative assumptions about the mapping from syntactic structures
to semantic representations at LF.

While Egg’s (2003) analysis works for strong quantifiers, it does not extend to weakly quanti-
fied nominals, such as cardinal phrases (e.g. eleven plays), measure phrases (e.g. two litres of
water) and pseudopartitive constructions (e.g. half of the soup). This is because the latter are
not usually analyzed as scope-taking operators subject to obligatory Quantifier Raising. And
yet, begin DP receives a distributive reading even when its complement is an indefinite cardinal
DP:

(25)  a.  On January 1st, Max began eleven plays by Shakespeare (#but he only started
Hamlet before he fell asleep).
   b.  On January 1st, Max began reading eleven plays by Shakespeare (but he only
started Hamlet before he fell asleep).

A similar observation applies to the pseudopartitive construction a quarter of his soup in (26)-
(27). The only difference is that the distributive operator must now apply to a mass noun
refferent, requiring us to impose some kind of partition onto the denotation of the soup (see
Schwarzschild, 1996, for a cover-based approach to distributivity). The purpose of this partition
is to divide the soup matter into a set of discrete and quantifiable units. I assume that the units
of soup making up the partition are derived atoms. This allows me to maintain the definition of
distributivity as universal quantification over atomic parts.

(26)  a.  ??Taking his first sip, Patrick began a quarter of his soup.
   b.  Taking his first sip, Patrick began eating a quarter of his soup.

(27)  a.  Patrick finished a quarter of his soup.
   b.  Patrick finished eating a quarter of his soup.

The hypothesis that begin/finish DP is obligatorily distributive with weakly quantified DPs
accounts for the contrast between (26a) and (27a). What these examples entail is that 25% of
the soup units are such that Patrick began/finished each of them. This paraphrase is compatible
with the meaning of finish, but it is distinctly odd in a situation in which Patrick has only just
started eating. To express the idea that Patrick intends to eat only a quarter of his soup (perhaps
because he is on a diet), only the begin VP construction can be used (26b).

More generally, begin and finish license different entailment patterns with respect to the part
structure of their complement. These patterns are schematized in (28): begin is upward-
entailing while finish is downward-entailing on their arguments. The downward-entailing prop-
erty of finish explains why finish DP is always compatible with distributivity. In turn, the
upward-entailing property of begin accounts for the strangeness of begin DP in non-distributive contexts.\(^6\)

\[(28)\quad \text{For all } x \text{ and } y \text{ such that } y \sqsubseteq x,\]

\[\begin{align*}
\text{a. } & \text{begin } y \text{ asymmetrically entails begin } x \\
& \text{e.g. begin the foundations of the house } \Rightarrow \text{ begin the house}
\end{align*}\]

\[\begin{align*}
\text{b. } & \text{finish } x \text{ asymmetrically entails finish } y \\
& \text{e.g. finish the house } \Rightarrow \text{ finish the foundations / the walls / the roof}
\end{align*}\]

All in all, the oddness of (26a) confirms that aspectual verbs with weakly quantified DP complements are obligatorily distributive. This fact is not predicted by Egg’s (2003) Quantifier Raising account. However, it finds a natural explanation if extent scales are computed on atoms, in accordance with the hypothesis in (9). Hard-wired into the measure-of-change function part\(_A\), the atomicity restriction requires begin to apply individually to each atom in the denotation of eleven plays and to each atomic unit in the partition of a quarter of his soup.

Interestingly, begin DP shares the property of distributivity with the preverbal half on its eventive use.\(^7\) The fact that begin eight films and half-watch eight films pattern together becomes clear when we compare them with begin watching eight films and partially watch eight films in (29a) and (29b), respectively.

\[(29)\quad \begin{align*}
\text{a. } & \text{On Monday, the critic began / half-watched eight films} \\
& \quad \text{(but he didn’t start the last one until Wednesday)}
\end{align*}\]

\[\begin{align*}
\text{b. } & \text{On Monday, the critic began watching / partially watched eight films} \\
& \quad \text{(but he didn’t start the last one until Wednesday)}
\end{align*}\]

Note that the clause in brackets is only compatible with a non-distributive construal, whereby begin and partially take scope over the complex event of the critic watching all eight films. To bring out this reading, imagine that the critic is contractually obliged to watch and review eight films for a weekly magazine. To the extent that this interpretation is not available in the (a) examples, we can conclude that begin eight films and half-watch eight films are obligatorily distributive.

The pattern in (29) falls into place once we observe that half is plausibly VP-internal, while the adverb partially is merged VP-externally. With respect to the VP-internal position of half, I follow Bochnak (2013) in assuming that half originates on the object, as in watch half of the film, and then prefixes to the verb at PF, yielding half-watch the film. The parallel behavior of VP-internal begin and half and VP-external begin and partially is captured by the following generalization:

\[(30)\quad \begin{align*}
\text{a. } & \text{VP-internal items apply to atomic Incremental Theme objects, giving rise to distributive readings with quantified DPs}
\end{align*}\]

\(^6\)This account predicts that begin a quarter of his soup should be felicitous in a more distributive context. To see that this is the case, imagine that Patrick has eight cans of soup in his cupboard, and that he subsequently opens and tastes two of them. In that scenario, it is true that Patrick began a quarter of his soup.

\(^7\)Bochnak (2013) distinguishes between two uses of the preverbal half: the eventive half ‘names the proportion of an event that is complete’ (e.g. John half-ate the apple in five minutes), while the evaluative half ‘makes a comment about the degree to which the event described represents a prototypical event of that type’ (e.g. Mary half-crawled into her seat). I am only concerned with the eventive use here.
b. VP-external items apply to complex event predicates, allowing for non-distributive readings with quantified DPs

As a final refinement, consider what happens when \( \text{begin} \) and \( \text{half} \) take definite plural complements, e.g. begin / half-watch the eight Oscar-nominated films. A non-distributive construal becomes available again: (31a) is compatible with a scenario in which the critic began only some of the films on Monday, while (31b) can describe an event of watching exactly four films from start to finish. The hypothesis in (30) can accommodate these data provided that there exists a semantic operation which maps plural individuals (e.g. \( \sigma[\lambda X.\text{films}(X)] \)) onto corresponding group individuals (e.g. \( \uparrow\sigma[\lambda X.\text{films}(X)] \)), and that group individuals are derived atoms (Landman, 2000). In (31), the operation of group formation turns the referent of the definite plural into an atomic group, which licenses an extent scale measuring the total runtime of the eight Oscar-nominated films.

(31) a. On Monday, the critic began the eight Oscar-nominated films...
   b. On Monday, the critic half-watched the eight Oscar-nominated films...
   (...but he didn’t start the last one until Wednesday)

6. Formal Analysis: Part II

What explains the restriction of VP-internal \( \text{begin} \) and \( \text{half} \) to atomic Incremental Theme objects? By hypothesis, the syntactic structure of begin eight films and half-watch eight films includes the functional morpheme \( \text{PART}_{\text{inc}} \), which introduces the measure-of-change function \( \text{part}_\Delta \) into the semantic computation. The \( \text{part}_\Delta \) is inherently partitive, tracking how much of the object \( x \) participates in the event \( e \). One way of modelling the part-whole relation is by treating the ‘whole’ as an atom, and by relating the latter to its parts via the material subpart relation \( \sqsubseteq_{\text{m}} \) (Link, 1983). On this view, the atomicity restriction is hard-wired into the meaning of \( \text{part}_\Delta \), thus deriving all the effects observed in the previous section.

To make this idea more explicit, I propose that \( \text{part}_\Delta \) is subject to the constraints in (32). According to (32a), the statement \( \text{part}_\Delta(x)(y)(e) = d \) conveys two pieces of information: firstly, \( y \) is the theme participant in \( e \); secondly, \( y \) constitutes a \( d \)-sized part of \( x \). The definition of the non-eventive partitive function \( \text{part}(x)(y) \) further specifies that \( x \) must be atomic and that \( y \) counts as its material subpart.

(32) a. \( \forall x,y,e,d[\text{part}_\Delta(x)(y)(e) = d \rightarrow \text{theme}(e) = y \land \text{part}(x)(y) = d] \)
   b. \( \forall x,y,d[\text{part}(x)(y) = d \rightarrow \text{atom}(x) \land y \sqsubseteq_{\text{m}} x] \)

Recall from Section 3 that the meaning of begin DP is computed by applying the aspectual function \( \text{begin} \) to the event predicate denoted by \( \text{part}_\Delta \) after the existential closure of its degree argument. This analysis assigns the semantics in (33a) to the VP begin the film.\(^8\) When the singular object is replaced with the plural eight films, the distributive operator \( \text{D} \) must apply to the latter to ensure that the atomicity restriction on \( \text{part}_\Delta \) is satisfied. In (33b), distributivity is equated with universal quantification over atoms.\(^9\) As a result, a new event of beginning a film is introduced for each atomic film in the denotation of eight films.

\(^8\)See (18) in Section 3 for the denotation of aspectual verbs.
a. \[ \exists e' \begin{array}{c} \text{begin} \\ \end{array} \exists d, y \left[ \Delta_{\text{film}}(y)(e) = d \land d = 1 \right] (e') \]

There exists an initial subevent \(e'\) of an event \(e\) such that \(e\) incrementally affects the extent of the film in some unspecified manner.

b. \[ \exists X. \text{films}(X) \land \|X\| = 8 \land \forall x \left[ x \subseteq X \rightarrow \exists e' \begin{array}{c} \text{begin} \\ \end{array} \exists d, y \left[ \Delta_x(y)(e) = d \land d = 1 \right] (e') \right] \]

There exists a plural individual \(X\) consisting of eight films such that for each film \(x\) there exists an initial subevent \(e'\) of an event \(e\) such that \(e\) incrementally affects the extent of \(x\) in some unspecified manner.

I do not provide denotation for half-watch eight films, but see Bochnak (2013) for the claim that the eventive half is a degree modifier, saturating the degree variable of \(\Delta\). Since the presence of half necessarily entails the presence of \(\text{PART}_{inc}\), the distributive operator must once again apply to eight films.

7. Extensions and Future Prospects

If the account above is on the right track, it suggests that future researach needs to be more careful in distinguishing between extent scales (licensed by \(\text{PART}_{inc}\) VP-internally) and quantity scales (computed VP-externally, perhaps at the level of the lower Asp head, as in Kratzer 2004 and Borer 2005). A dissociation between extent and quantity scales becomes apparent in iterative examples like (34) below. Even though pizzas and sodas are homogenous predicates, the presence of atoms in their denotations suffices to license the in X time adverbial in (34a). I suggest that, in this case, the in X time adverbial is licensed by \(\Delta\) applying to atomic entities. If correct, this entails that Incremental Theme predicates like eat three pizzas are doubly delimited, once by the extent scales corresponding to atomic pizzas and once by the quantity scale associated with the numeral three.

(34) a. John ate pizzas / drank sodas in ten minutes for an hour straight
b. John ate pizza / drank soda *in ten minutes for an hour straight

(adapted from MacDonald, 2008)

Furthermore, \(\Delta\) has the right properties to account for non-culminating accomplishments in the Hindi neutral perfective (35a). The difference between Hindi and English is that the former binds the degree argument of \(\Delta\) existentially (entailing the consumption of some but not necessarily all cake), while the latter sets it to the maximum value by default (implying the consumption of the entire cake). Crucially, the non-maximality of \(\Delta\) in Hindi is preserved even under the scope of numerals: the sentence in (35b) has a strongly distributive flavor, echoing the obligatory distributivity of begin five apples in English.

(35) a. māe ne aaj apnaa kek khaayaa aur baakii kal khaaūūghaa
   ‘I ate my cake today and I will eat the remaining part tomorrow’
   I ERG today mine cake eat.PERF and remaining tomorrow eat.FUT
b. amu ne pāac seb khaaye
   ‘Amu ate five apples’ (not necessarily entirely, but each of the apples was affected)
   Amu ERG five apples eat.PERF

(adapted from Singh, 1998)
I leave the relation between \( \text{part}_\Delta \) and non-culminating accomplishments in Hindi as a potential avenue for future research.

8. Summary

This paper has presented new data in support of Rappaport Hovav’s (2008) hypothesis that extent scales originate on Incremental Theme objects in the process of VP composition. The relevant evidence comes from the \( \text{begin DP} \) construction, whose interpretation is restricted to underspecified Incremental Theme events. The absence of other readings is expected if property and complex path scales are hard-wired into the lexical semantics of such verbs as \textit{heat}, \textit{dim} and \textit{cross}.

What is more, I have defended the view that extent scales are formally introduced by the Incremental Theme morpheme \( \text{PART}_{inc} \), which combines with the direct object to yield a gradable property of events (Kennedy, 2012; Bochnak, 2013). The adoption of \( \text{PART}_{inc} \) into the functional inventory has paved the way for a new analysis of \( \text{begin/finish DP} \): aspectual verbs, which take event predicates as arguments, can now apply to \( \text{[PART}_{inc} \text{ DP]} \) after the degree variable has been existentially closed. In other words, \( \text{PART}_{inc} \) has the right properties to mediate the semantic composition of aspectual verbs with DP complements.

Finally, I have pointed out that examples like \textit{begin eight films} and \textit{half-watch eight films} are obligatorily distributive. This observation has led me to propose that the measure-of-change function \( \text{part}_\Delta \) imposes an atomicity restriction on its first argument. The reason for this restriction is that the meaning of \( \text{part}_\Delta \) is built on the semantics of partitivity. To model the part-whole relation, I hypothesized that the ‘whole’ is conceptually represented as an atom, and that it is related to its internal structure via the material subpart relation \( \sqsubseteq_m \).

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Vietnamese subcomparatives, the grammar of degrees, and comparative deletion
Tyler LEMON — University of California, Berkeley

Abstract. Beck et al. (2009) conducted a cross-linguistic survey of degree constructions and proposed three parameters to classify languages according to the constructions they allow and their available interpretations: 1. whether a language has degrees in its semantics; 2. whether a language has degree abstraction; and 3. whether a language allows the degree argument position of a gradable predicate to be overtly filled. This paper provides novel data from Vietnamese that test the predictions of these parameters. Languages with clausal comparatives and a positive setting for these parameters should allow subcomparatives. This paper shows that Vietnamese is such a language, but despite this, many subcomparatives are ungrammatical. Further examination of the data reveals a crucial generalization: a predicate’s ability to remain in the standard of a subcomparative is linked to its ability to interact with nhiều ‘much, many’. I propose that this generalization can be captured by positing that degrees combine directly with some Vietnamese predicates, while in other cases degrees combine with nhiều or its silent counterpart μ before combining with predicates, an idea inspired by Bresnan (1973), Grano and Kennedy (2012) and Wellwood (2012). I also propose a mandatory deletion operation that occurs in the standards of Vietnamese comparatives, forcing predicates to elide when they combine directly with degrees but allowing them to remain overt when degrees must first combine with những/μ.

Keywords: Vietnamese, degree, subcomparative, typology, comparative deletion.

1. Introduction

In their cross-linguistic survey of comparatives and other constructions with degrees, Beck et al. (2009) propose three parameters along which languages may be classified (1):

1. a. **Degree Semantics Parameter (DSP):** A language {does/does not} have gradable predicates, i.e. lexical items that introduce degree arguments.
   b. **Degree Abstraction Parameter (DAP)** A language {does/does not} have binding of degree variables in the syntax, i.e. degree abstraction.
   c. **Degree Phrase Parameter (DegPP):** The degree argument position of a gradable predicate {may/may not} be overtly filled.

A language with a positive setting for all three parameters and clausal comparatives (2b) should allow difference comparatives (3a) and comparisons with degrees (3b) (+DSP), exhibit negative island effects (3c) and scope ambiguities (3d) (+DAP), and allow degree questions (3e), measure phrases (3f), and subcomparatives (3g) (+DegPP). English is an example of this type of language (Beck et al., 2009: 13, 28), and it meets these expectations.

2. a. **Phrasal comparative:** John is taller than [Mary]. (surface DP standard)
   b. **Clausal comparative:** John is taller than [Mary thought]. (surface CP standard)

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(3)  a. **Difference comparative**: John is 2 inches taller than Mary.
b. **Comparison with a degree**: John is taller than 6 feet.
c. **Negative island effect**: *John bought a more expensive book than nobody did.
d. **Scope ambiguity**: The paper is 10 pages long. It must be exactly 5 pages longer.  
   ✓ Reading 1 (*must > DegP*): The paper must be exactly 15 pages long and no more.
   ✓ Reading 2 (DegP > *must*): The paper must be at least 15 pages long.
e. **Degree question**: How tall is John?
f. **Measure phrase**: John is 6 feet tall.
g. **Subcomparative**: John is taller than the car is long.

As I argue below, Vietnamese is also a language with a positive setting for all three parameters that allows clausal comparatives. It largely conforms to the predictions of Beck et al.’s (2009) typology, but there is one exception. Many subcomparatives are ungrammatical (4a); their meanings must be expressed by nominalizing the gradable predicate in the standard (4b).

   CLF table long exc. CLF chair tall
   Int. ‘The table is longer than the chair is tall.’  
   (NPD, PK)
b. Chiều dài của cái bàn hơn chiều cao của cái ghế.
   direction long of  CLF table exc. direction tall of  CLF chair
   ‘The length of the table exceeds the height of the chair.’  
   (NPD)

Interestingly, certain subcomparatives are acceptable in Vietnamese, with some subject to speaker variation (indicated by %, 5a). Thus, there are some subcomparatives that are unacceptable to all speakers (4a), some that are acceptable to some speakers but not others (5a), and some that are acceptable to all speakers (5b).

(5)  a. % Mary vui hơn John buồn.
   Mary happy exc. John sad
   ‘Mary is happier than John is sad.’  
   (✓ NPD, *PK)
b. Phoebe thích hoá học hơn là Tyler thích toán.
   Phoebe like chemistry exc. C Tyler like math
   ‘Phoebe likes chemistry more than Tyler likes math.’  
   (✓ NPD, ✓ PK)

I argue that this pattern is the result of differences in the ways that predicates interact with degree expressions (i.e. Deg/DegP) in Vietnamese. More specifically, I argue that some predicates like *cao* ‘tall’ are inherently gradable and can combine directly with degrees; these are type <d,et> (von Stechow, 1984). Other predicates like *thích* ‘like’ cannot combine directly with degrees. Instead, degree expressions first combine with an additional morpheme *nhiều* ‘much, many’ or, in some cases, its silent counterpart *µ* before combining with these predicates, an idea inspired by Bresnan (1973), Grano and Kennedy (2012) and Wellwood (2012). This difference in how predicates compose with degree expressions interacts with a comparative deletion operation that forces the complement of Deg to elide in the standard of comparatives. The result is that predicates that combine directly with Deg must elide, but predicates for which the relationship with degree expressions is mediated by *nhiều/µ* may remain. This analysis shows

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2Throughout this paper, I use **Int.** and **exc.** as abbreviations for “intended meaning” and “exceed” respectively.
that being +DSP, +DAP, and +DegPP and having clausal comparatives is not enough for a language to allow subcomparatives. The language must also combine predicates with degrees in such a way that its comparative deletion operation allows them to remain.

This paper proceeds as follows. Section 2 shows that Vietnamese has clausal comparatives and is +DSP, +DAP, and +DegPP. Section 3 discusses subcomparatives of varying grammaticality as well as repair strategies. Section 4 discusses the distribution of nhiều ‘much, many’ with a focus on nominal comparatives and intensification with rất ‘very’ and rất nhiều ‘very much’, and it connects these data to the subcomparative data in section 3. Section 5 presents the analysis of how different predicates interact with degree expressions. Section 6 concludes.

2. Overview of Vietnamese degree constructions

In this section, I provide novel data on Vietnamese comparatives and other constructions with degrees in order to demonstrate that Vietnamese allows clausal comparatives and should be considered +DSP, +DAP, and +DegPP in Beck et al.’s (2009) typology. These generalizations predict the availability of subcomparatives in Vietnamese, making the fact that many subcomparatives are ungrammatical rather surprising.

2.1. Basic comparatives and the possibility of clausal standards

Vietnamese forms comparatives from non-comparatives by following a gradable predicate with hơn, a verb that means ‘surpass’, ‘exceed’, or ‘be more than’, and an optional standard (6).

(6) a. Wes cao. (NBT) 
   ‘Wes is tall.’ (NBT)

b. Huế nhỏ. (NBT) 
   ‘Hue is small.’ (NBT)

c. Tôi thích phở. (NPD) 
   ‘I like pho.’ (NPD)

d. Tyler cao hơn (Nathalie). (NBT) 
   ‘Tyler is taller (than Nathalie).’ (NBT)

e. Huế nhỏ hơn Hà Nội. (NBT) 
   ‘Hue is smaller than Hanoi.’ (Ansaldo, 2010: 939)

f. Tôi thích phở hơn Phoebe. (NPD) 
   ‘I like pho more than Phoebe.’ (NPD)

Examples (6d)-(6f) show that Vietnamese allows (surface) phrasal standards, but clausal (CP) standards are also possible. There are several pieces of evidence for clausal standards. The first is the optional use of an overt complementizer là (Trinh, 2005; Tran, 2009) in examples where the standard has clausal syntax (7) and even with overtly phrasal standards (8). là is also used outside of comparatives to introduce embedded clauses after a variety of predicates (9).

(7) a. Phoebe giàu hơn (lá) tôi tưởng. (C) 1SG think
   ‘Phoebe is richer than I thought.’ (NPD)

b. Phoebe hát ồn hơn (lá) Tyler huýt sáo. (C) Tyler whistle
   ‘Phoebe sang louder than Tyler whistled.’ (NPD)

(8) Tôi thích trà hơn (lá) cà phê.  
    ‘I like tea more than coffee.’ (NPD, cf. Tran et al., 2012: 111)
There is also other, stronger evidence for clausal standards. One such piece of evidence is the possibility of multiple standards. Under the assumption that elements that introduce standards (than in English, Hơn in Vietnamese) can only really take one standard complement, multiple standards result from clausal reduction (Lechner, 2001; Bhatt and Takahashi, 2011). English allows such clausal reduction to derive multiple standards (10a). Vietnamese does as well (10b).

(10) a. Tina read more books today than Pim read many books yesterday. (Bhatt and Takahashi, 2011: 594; reduction based on Lechner, 2001: 694)

b. Hôm nay Sài Gòn nóng hơn Hà Nội đó nóng hôm qua.
   ‘Today Saigon is warmer than Hanoi was yesterday.’ (NPD)

The last piece of evidence that Vietnamese allows clausal standards comes from the scope interpretations available to quantifiers inside the standard (Bhatt and Takahashi, 2011: 602). If the standard is a CP, then a quantifier can take scope inside it, and thus below -er or the language equivalent. By contrast, if the standard is a DP, then the quantifier must scope above -er, because it would have no clause in the standard within which to take scope. In an English sentence like (11), there are two possible readings corresponding to -er > every and every > -er, though speakers typically agree that the every > -er reading is much more difficult to access.

(11) a. More students read every syntax paper than (read) every semantics paper.

b. ✓ Reading 1 (-er > every): The number of students who read every syntax paper exceeds the number of students who read every semantics paper.

c. ?? Reading 2 (every > -er): The least read syntax paper was still read by more students than every semantics paper.  (Bhatt and Takahashi, 2011: 602)

Vietnamese patterns like English with respect to these judgments. A surface phrasal comparative with a quantifier standard shows the same scope ambiguity (12), indicating both that clausal standards are possible and that surface phrasal standards can be derived from clausal reduction.

(12) a. Nhiều sinh viên đã đọc mọi bài viết sinh học hơn mọi bài viết hóa học.
   ‘More students read every biology paper than every chemistry paper.’

b. ✓ Reading 1 (-er > every)

c. ✓/? Reading 2 (every > -er)  (PK, similar example tested with NPD)

Taken together, all of these pieces of evidence, namely the possibility of overt complementizers in standards, the possibility of multiple standards via clausal reduction, and scope ambiguity for quantifiers in standards, show that Vietnamese allows clausal standards and the derivation of phrasal standards from clausal sources. This suggests that Hơn ‘exceed’ functions like its English analogue -er, often described as the “2-place -er”. A denotation for Hơn is provided in (13a) along with a denotation for max(P) (13b). These denotations draw from Heim (2000: 42), Beck et al. (2009: 5), and Bochnak (2018: 364). This Hơn is designated HômNC for “normal comparative”. This is to differentiate it from versions of Hôm used in other degree constructions.
As noted above, clausal standards are necessary for subcomparatives. Beyond this fact about the syntax of comparatives, the grammar of degrees must also work in a certain way to permit subcomparatives. I now turn to showing that the grammar of degrees predicts the availability of subcomparatives in Vietnamese.

2.2. Evidence for lexical items that introduce degree arguments (+DSP)

To show that Vietnamese has lexical items that introduce degree arguments, we need to look at constructions that reference degrees directly (Beck et al., 2009: 18). One such construction is difference comparatives. These feature measure phrases that describe the degree to which two entities differ on the scale referenced by the predicate (height in (14a), age in (14b)). This measure phrase is incorporated as a type \( d \) argument of \( \text{hơn} \) ‘exceed’; a denotation based on Beck et al. (2009) is provided in (15). This \( \text{hơn} \) is designated \( \text{hơn}_{\text{DC}} \) for “difference comparative”.

(14) a. Tucker cao hơn Tyler mười phân. Tucker tall exc. Tyler ten cm

‘Tucker is 10 cm taller than Tyler.’ (NBT)

(15) \[ \text{hơn}_{\text{DC}} = \lambda d'. \lambda P_{d<d'}, \lambda Q_{d<d'}, \text{max}(Q) \geq \text{max}(P) + d' \]

Another construction that provides evidence for lexical items that introduce degree arguments is comparisons with degrees. In this construction, the standard is a measure phrase of type \( d \), and it is compared directly with the degree to which some entity embodies some predicate. Some Vietnamese examples are provided in (16), and the relevant denotation for \( \text{hơn} \) (designated \( \text{hơn}_{\text{CWD}} \) for “comparison with degree”) is provided in (17).

(16) a. Tudor cao hơn một thước. Tudor tall exc. one meter

‘Tudor is taller than one meter.’ (NBT)

(17) \[ \text{hơn}_{\text{CWD}} = \lambda d'. \lambda P_{d<d'}, \lambda Q_{d<d'}, \text{max}(Q) > d' \]

2.3. Evidence for degree abstraction (+DAP)

If a language has degrees, then one can ask the question of whether that language has degree abstraction (Beck et al., 2009: 22). Degree abstraction comes in two forms. The first is a type of quantifier raising in which a DegP of type \( <d, t> \) headed by -er raises for reasons of semantic composition (Heim, 2000). It cannot compose in its base position, where it would need to be type \( d \). This is shown with an English example in (18), where the matrix DegP -er than Mary is d-tall undergoes degree abstraction, with is d-tall eliding. This exact structure has not been proposed before to my knowledge, and it is not the one that I will adopt for Vietnamese, but it suffices for our current purposes. For evidence that the subjects of adjectives are generated external to AP in a projection like PredP, see Baker (2003) and Meltzer-Asscher (2011).
The second form of degree abstraction occurs in CP standards. This form of degree abstraction is a type of predicate abstraction (Heim and Kratzer, 1998) with a degree operator. This operator creates a $\lambda$ at the left edge of the embedded CP, making the CP type $<d,t>$ and allowing the CP and the semantically vacuous than to compose with -er (Chomsky, 1977) (18). Details about the semantics of (18) are provided in (19).

(18) John is taller than Mary is d-tall.

(19) a. $\text{[tall]} = \lambda d,\lambda x.\text{tall}(x) \geq d$ (Beck et al., 2009: 4)
b. $\text{[-er]} = \lambda P_{<d,t>},\lambda Q_{<d,t>}.\text{max}(Q) > \text{max}(P)$ (Beck et al., 2009: 5)
c. $[\text{max}(P)] = td.P(d) = 1$ & $\forall d'[P(d') = 1 \rightarrow d' \leq d]$ (Beck et al., 2009: 5)
d. $[\text{CP}] = \lambda d,\text{tall}(\text{Mary}) \geq d$
e. $[\ldots] = \lambda d,\text{tall}(\text{John}) \geq d$
f. $[\text{DegP_1}] = \lambda Q_{<d,t>}.\text{max}(Q) > \text{td.tall}(\text{Mary}) \geq d$ & $\forall d'[\text{tall}(\text{Mary}) \geq d' \rightarrow d' \leq d]$ 
g. $[\text{TP_3}] = \text{td.tall}(\text{John}) \geq d$ & $\forall d'[\text{tall}(\text{John}) \geq d' \rightarrow d' \leq d] > \text{td.tall}(\text{Mary}) \geq d$ & $\forall d'[\text{tall}(\text{Mary}) \geq d' \rightarrow d' \leq d]$

In some languages this degree operator movement is overt, resembling a form of wh-movement (Chomsky, 1977: 87). Hungarian (20a) and some varieties of English (20b) are examples.
The Vietnamese data available to me generally lack an overt *wh*-word or any overt sign of a degree operator. Fortunately, there are ways to test for degree abstraction without overt operators. Silent operator movement is subject to islands (Chomsky, 1977: 87), so if comparatives that would force movement out of an island are ungrammatical, this would provide evidence for degree abstraction. One type of island that has been tested in a variety of languages is negative islands (Beck et al., 2009). Negative island effects result from degree abstraction across a negative word to create a \(<d, t>\) argument for -er and its equivalents in other languages. Thus, languages with degree abstraction like English and Vietnamese show these effects (21).

\[\text{(21) a. * Anh Tyler dã mua một quyển sách dắt hơn không ai mua.}
\text{brother Tyler PST buy one CLF book expensive exc. NEG who buy}
\text{Literally: ‘Tyler bought a more expensive book than nobody did.’ (NBT/NPD)}\]

\[\text{b. Anh Tyler dã mua một quyển sách dắt hơn ai khác mua.}
\text{brother Tyler PST buy one CLF book expensive exc. who other buy}
\text{‘Tyler bought a more expensive book than anybody else did.’ (NBT)}\]

Negative islands in comparatives are a result of semantic uninterpretability, rather than a syntactic restriction on movement. The embedded CP in (21a) has a denotation like the one in (22). This is a \(<d, t>\) argument appropriate for composition with -er\(\text{hit}\)en. However, the maximum of this CP is undefined (von Stechow, 1984; Rullman, 1995; Beck et al., 2004, 2009). There is not a unique highest degree of expensiveness such that nobody bought a book that expensive.

\[\text{(22) } \text{[CP]} = \lambda d. t. \text{nobody bought a d-expensive book} \quad \text{(based on Beck et al., 2009: 11)}\]

Another piece of evidence that Vietnamese has degree abstraction is the existence of scope ambiguities in the interpretation of comparatives with a modal in the matrix clause (Heim, 2000; Beck et al., 2009: 9). If both the matrix DegP and matrix modal can undergo some form of quantifier raising to compose semantically, then one might expect that the landing sites can be ambiguous relative to one another, leading to possible ambiguity in interpretation. In (23), varying the relative scopes of the modal phải ‘must’ and DegP produces distinct readings.

\[\text{(23) a. Bây giờ bài viết dài mười trang. Giáo sư nói là bài viết phải dài hơn đúng năm trang.}
\text{now essay long ten page professor say C essay must long exc. exact năm trang.}
\text{five page}
\text{‘Now the essay is 10 pages long. The professor says that the essay must be exactly 5 pages longer.’ (cf. Heim, 2000: 48)}\]

\[\text{b. } \checkmark \text{ must } > \text{DegP } \forall w \in \text{Acc: max}\{d: \text{the essay is } d\text{-long in } w\} = 15 \text{ pages}
\text{‘The essay must be exactly 15 pages long and no more.’}\]

\[\text{c. } \checkmark /? \text{ DegP } > \text{must } \max\{d: \forall w \in \text{Acc: the essay is } d\text{-long in } w\} = 15 \text{ pages}
\text{‘The essay must be at least 15 pages long.’ (NPD)}\]
2.4. Evidence for the overt filling of degree argument positions (+DegPP)

So far, I have presented evidence that Vietnamese has degrees (+DSP) and degree abstraction (+DAP), and the data fit these claims quite cleanly. The evidence that Vietnamese allows the overt filling of the degree argument position of a gradable predicate (+DegPP) is a bit less clear-cut. Nevertheless I will argue that Vietnamese does indeed allow it.

If one assumes a structure for comparative sentences along the lines of the one in (18), then DegP is an argument of a gradable predicate (tall in that case). In some languages, DegP may be filled overtly in the syntax, but in others, there appears to be a restriction against this. Phrases that can fill DegP in English include degree question phrases (24a), measure phrases (24b), and degree traces from degree operator movement (24c) (Beck et al., 2009: 24).

\begin{enumerate}
\item \[\text{AP [DegP How] [A tall]] is John?}\]
\item John is \[\text{AP [DegP 6 feet] [A tall]]].\]
\item John is taller than \[\text{CP λd_{d} the car is [AP [DegP t_d] [A long]]}].\]
\end{enumerate}

As noted above, the Vietnamese data are a bit ambiguous in showing whether or not the language allows DegP to be overtly filled. Vietnamese allows degree questions (25) and direct measure phrases (26), but subcomparatives are often ungrammatical (4a, repeated as 27).

\begin{enumerate}
\item Philip cao bao nhiêu?
\item Cô ấy đẹp có nào?
\item Cái bàn dài hơn cái ghế cao.
\end{enumerate}

\begin{enumerate}
\item \[\text{Philip tall how much} \quad \text{‘How tall is Philip?’ (NBT)}\]
\item \[\text{aunt that beautiful size which} \quad \text{‘How beautiful is she?’ (PK)}\]
\item \[\text{CLF film cinema this long how long} \quad \text{‘How long is this film?’ (NBT)}\]
\item \[\text{CLF film cinema this long three hour} \quad \text{‘This film is 3 hours long.’ (NBT)}\]
\item \[\text{CLF table long exc. CLF chair tall} \quad \text{Int. ‘The table is longer than the chair is tall.’ (NPD, PK)}\]

Despite the ungrammaticality of subcomparatives like (27), the possibility of degree questions (25) and direct measure phrases (26) indicates that DegP can be overtly filled in Vietnamese. I will ultimately depart from the syntax assumed in Beck et al. (2009), assuming instead that predicates that combine with degrees directly are arguments of Deg, rather than the reverse. Regardless, it is clear that degree expressions can co-occur overtly with gradable predicates.

2.5. Section summary

In this section I have shown that Vietnamese has clausal comparison, degrees (+DSP), and degree abstraction (+DAP) and allows gradable predicates to co-occur overtly with degree expressions (+DegPP). The evidence for clausal comparison, degrees, and degree abstraction is
clear and matches closely with data in other languages. The evidence that degree expressions may co-occur overtly with gradable predicates comes most directly from degree questions and measure phrases. All of these facts about the grammar of degrees in Vietnamese predict the general availability of subcomparatives, but, as noted above, many subcomparatives are ungrammatical. In fact, the data on subcomparatives are complicated, and a full treatment of these data is in order. The next section discusses Vietnamese subcomparatives in more detail.

3. Vietnamese subcomparatives

As noted above, many subcomparatives are ungrammatical in Vietnamese, but there are also some that are grammatical for some speakers only and others that are grammatical for all speakers. In this section the data are presented in greater detail. First, some examples of subcomparatives that are ungrammatical for all speakers consulted are provided in (28)-(29).

   CLF table long exc. CLF chair tall
   Int. ‘The table is longer than the chair is tall.’ (*NPD/PK, similar example rejected by NBT and BQL)
   b. Chiều dài của cái bàn hơn chiều cao của cái ghế.
   direction long of CLF table exc. direction tall of CLF chair
   ‘The length of the table exceeds the height of the chair.’ (√ NPD)

   1SG tall exc. car long
   Int. ‘I’m taller than the car is long.’ (*NPD/PK)
   b. Tôi cao hơn chiều dài của xe hơi.
   1SG tall exc. direction long of car
   Int. ‘I’m taller than the length of the car.’ (√ NPD)

In (28), the ungrammatical subcomparative (28a) is repaired by nominalizing both of the gradable predicates (28b). (29) shows that only the gradable predicate in the standard needs to be nominalized. These examples are perhaps the closest to the examples of subcomparatives from other languages seen in the literature, which compare two physical-dimension predicates with maxima on the positive ends of their scales. The repairs show that the intended meanings of these subcomparatives are clear to speakers, but they cannot be expressed as subcomparatives.

The next set of subcomparatives are those that are subject to speaker variation. The examples in (30) feature a different set of predicates more subjective than the ones in (28)-(29); the scales for beauty and happiness are less clear than the scales for length and height. These examples are not perfect to consultant NPD, but they are judged grammatical. Consultant PK rejects them.

(30) a. % Mary vui hơn John buồn.
   Mary happy exc. John sad
   ‘Mary is happier than John is sad.’ (√ NPD, *PK)
   b. % John xấu hơn Mary đẹp.
   John ugly exc. Mary beautiful
   ‘John is uglier than Mary is beautiful.’ (√ NPD, *PK)

The last set of subcomparatives (31) is considered acceptable by all speakers consulted. These involve transitive verbs, and though that certainly differentiates them syntactically, I would argue that these are still subcomparatives, because both predicates being compared are present overtly. In (31a), degrees of liking are being compared, and in (31b), a degree of liking is being compared to a degree of hating. This is different from an example like (7b), repeated as (32), where degrees of loudness are being compared, but the embedded ồn ‘loud’ has elided.
(31) a. Phoebe thích hoá học hơn là Tyler thích toán.
   ‘Phoebe likes chemistry more than Tyler likes math.’ (√ NPD/PK)

   b. Phoebe thích hoá học hơn là Tyler ghét toán.
   ‘Phoebe likes chemistry more than Tyler hates math.’ (√ NPD/PK)

(32) Phoebe hét âm hơn là Tyler huýt sáo dồn.
   ‘Phoebe sang louder than Tyler whistled d-loud.’ (NPD)

Given the evidence that Vietnamese is +DSP, +DAP, and +DegPP and allows clausal standards, it is surprising that some subcomparatives are ungrammatical (28a, 29a). It is less surprising typologically that other subcomparatives are acceptable (31), though some of them only to some speakers (30). There is also the puzzle internal to Vietnamese of explaining this distribution, both accounting for ungrammaticality and allowing for variation. The next section describes the distribution of nhiều ‘much, many’, revealing intriguing differences between the predicates shown in the subcomparatives in this section and paving the way towards an analysis.

4. Towards an analysis: The distribution of nhiều ‘much, many’

The word nhiều ‘much, many’ plays an important role in the grammar of degrees in Vietnamese. Its use with a predicate correlates with the ability of that predicate to remain in the standards of comparatives and form subcomparatives. This section illustrates this correlation with data on nominal comparatives and intensification with rất ‘very’ and rất nhiều ‘very much’.

Nominal comparatives in Vietnamese, in addition to using hơn ‘exceed’, are formed with nhiều ‘much, many’ preceding the matrix-clause noun that it measures. Notably, nhiều cannot be present in the standard, but everything else can be, including the measured noun (33a-33c). On the other hand, nhiều must be present in the matrix clause (33c). There is a preference for eliding other identical material in the standard (33d), but only nhiều absolutely must elide.

(33) a. Lan đã ăn nhiều phở hơn Thoa ăn cơm chiên.
   Lan PST eat much pho exc. Thoa eat rice fry
   ‘Lan ate more pho than Thoa ate d-much fried rice.’ (NPD)

   b. Nhiều sinh viên học lịch sử hơn giáo sư học tâm lý học.
   ‘More students study history exc. professor study psychology’ (NPD)

   c. Thoa mua *(nhiều) nhà hơn Vụ mua *(nhiều) xe hơi.
   Thoa buy *(much) house exc. Vụ buy *(much) car
   ‘Thoa bought more houses than Vụ bought d-many cars.’ (NPD)

   d. Nhiều sinh viên học lịch sử hơn *(nhiều)ि sinh viên học tâm lý học.
   ‘More students study history exc. *(m) students study psychology’ (NPD)

Perhaps the most interesting data on nhiều ‘much, many’ in light of the subcomparative data concern the possibility of intensification with rất ‘very’ and rất nhiều ‘very much’. Rất must precede phonological material, either nhiều or a predicate if nhiều is absent.
All the predicates for which subcomparative data were presented (28-31) can be intensified with a preceding **rất** ‘very’, but not all of them can be intensified with a following **rất nhiều** ‘very much’. The availability of intensification with a following **rất nhiều** ‘very much’ correlates with the possibility of forming a subcomparative with that predicate. (34) presents predicates that all speakers reject in subcomparatives: **cao** ‘tall’ and **dài** ‘long’. These predicates allow preceding **rất** ‘very’ (34a,b) but not following **rất nhiều** (34c,d).

(34) a. Tôi **rất** **cao**.  
    1SG very tall  
    ‘I’m very tall.’ (√ NPD/PK)  
    Int. ‘I’m very tall.’ (*NPD/PK)

b. Cái **ghế** **rất** **dài**.  
    CLF chair very long  
    ‘The chair is very long.’ (√ NPD/PK)  
    Int. ‘The chair is very long.’ (*NPD/PK)

c. * Tôi **rất** **cao** **nhiều**.  
    1SG tall very much  
    ‘I’m very tall.’ (*NPD/PK)

d. * Cái **ghế** **dài** **rất** **nhiều**.  
    CLF chair long very much  
    ‘The chair is very long.’ (*NPD/PK)

(35) presents predicates that are possible in subcomparatives for consultant NPD but not consultant PK: **vui** ‘happy’ and **đẹp** ‘beautiful’. Both speakers accept these predicates with preceding **rất** ‘very’ (35a,b), but only NPD accepts them with following **rất nhiều** ‘very much’ (35c,d).

(35) a. Tôi **rất** **vui**.  
    today 1SG very happy  
    ‘I’m very happy.’ (√ NPD/PK)  
    ‘I’m very happy.’ (√ NPD, *PK)

b. Mary **rất** **đẹp**.  
    Mary very beautiful  
    ‘Mary is very beautiful.’ (√ NPD/PK)  
    ‘Mary is very beautiful.’ (√ NPD, *PK)

c. % Tôi **vui** **rất** **nhiều**.  
    1SG happy very much  
    ‘I really like Phoebe.’ (√ NPD/PK)

d. % Mary **đẹp** **rất** **nhiều**.  
    Mary beautiful very much  
    ‘Mary is very beautiful.’ (√ NPD, *PK)

(36) presents predicates that all speakers accept in subcomparatives: **thích** ‘like’ and **ghét** ‘hate’. As expected, both **rất** ‘very’ and **rất nhiều** ‘very much’ are acceptable to all speakers consulted.

(36) a. Tôi **rất** **thích** Phoebe.  
    1SG very like Phoebe  
    ‘I really like Phoebe.’ (√ NPD/PK)  
    ‘I really like Phoebe.’ (√ NPD/PK)

b. Tôi **rất** **ghét** Phoebe.  
    1SG very hate Phoebe  
    ‘I really hate Phoebe.’ (√ NPD/PK)  
    ‘I really hate Phoebe.’ (√ NPD/PK)

c. Tôi **thích** Phoebe **rất** **nhiều**.  
    1SG like Phoebe very much  
    ‘I really like Phoebe.’ (√ NPD/PK)

d. Tôi **ghét** Phoebe **rất** **nhiều**.  
    1SG hate Phoebe very much  
    ‘I really hate Phoebe.’ (√ NPD/PK)

Before moving on, I should note that not all verbal predicates can be intensified with a preceding **rất** ‘very’. Descriptively, this is only possible for stative verbs. Active verbs like **ăn** ‘eat’ and **hát** ‘sing’ require **nhiều** ‘much’ (37). They must also use **nhiều** in comparatives (38).

(37) a. * Tôi **rất** **ăn** phở.  
    1SG very eat pho  
    Int. ‘I eat pho a lot.’ (NPD)  
    ‘I eat pho a lot.’ (NPD)

b. * Tôi **rất** **hát**.  
    1SG very sing  
    Int. ‘I sing a lot.’ (NPD)  
    ‘I sing a lot.’ (NPD)

c. Tôi **ăn** phở **rất** **nhiều**.  
    1SG eat pho very much  
    Int. ‘I eat pho a lot.’ (NPD)

d. Tôi **hát** **rất** **nhiều**.  
    1SG sing very much  
    ‘I sing a lot.’ (NPD)

*Vietnamese does not make a true distinction between adjectives and verbs. More accurately, verbs could be classified as active or stative. Stative verbs include many lexical items translated as adjectives in English (Thompson, 1965: 217; Lê and Nguyễn, 2013: 85).
The key generalization that emerges from the data presented in this section is that predicates that can be modified by *nhiều* ‘much, many’ for intensification or in comparatives can remain in the standard following *hơn* ‘exceed, -er’. Nouns are modified by *nhiều* in nominal comparatives, so they can remain in the standard. In addition, verbs that can be intensified by *rất nhiều* ‘very much’ can remain in the standard of (sub)comparatives, and the variation seen in the acceptability of some subcomparatives (30) correlates with this across speakers. These correlations reveal the importance of *nhiều* in Vietnamese degree constructions. In fact, *nhiều* is often necessary (33, 37-38). An analysis of these constructions should account for *nhiều*’s distribution and contribution to the grammar of degrees in Vietnamese. In the following section, I propose an analysis of Vietnamese subcomparatives and degree constructions more broadly in which *nhiều* and its silent counterpart µ serve as intermediaries between predicates and degrees.

5. Subcomparatives and the grammar of degrees in Vietnamese

In this section I present my analysis of the grammar of degrees in Vietnamese. This includes two parts. The first concerns the ways different predicates combine with degree expressions and crucially how they can differ from one another. The second concerns the nature of comparative deletion in Vietnamese and how to determine what must elide and what may remain overt.

5.1. Proposal part 1: Vietnamese predicates and degrees

Data in the previous section showed that Vietnamese predicates, here meaning both verbs and nouns, differ in their compatibility with *nhiều* ‘much, many’. Some predicates like *cao* ‘tall’ and *dài* ‘long’ are incompatible with *nhiều* for intensification. Some like *thích* ‘like’ and *ghét* ‘hate’ are compatible with *nhiều* for intensification but do not require it. Some like *vui* ‘happy’ and *dep* ‘beautiful’ are subject to speaker variation, behaving like *cao* and *dài* for some speakers but like *thích* and *ghét* for others. Finally, some like *hát* ‘sing’ and *ăn* ‘eat’ require *nhiều*. The verbal predicates that require *nhiều* for intensification pattern with nouns like *sinh viên* ‘student’ (and others) in that they additionally require *nhiều* in comparatives. Thus, the broad generalization that emerges from this is that some predicates need *nhiều* to interact with and make reference to degrees, others do not need *nhiều*, and others can optionally use *nhiều*.

I propose that this variation in the behavior of predicates is due to differences in how predicates interact with degrees. Some predicates can combine directly with degree expressions, i.e. a Deg/DegP of type d or that leaves a trace of type d. In line with the traditional analysis (von Stechow, 1984; Heim, 2000; Beck et al., 2009; among others), I will assume that such predicates denote a relation between individuals and degrees (type <d,e,t>). Predicates of this nature include *cao* ‘tall’ and *dài* ‘long’ as well as some not discussed in this paper like *nặng* ‘heavy’ and *nóng* ‘hot’. Denotations are given below with English meta-language (39).

\[
\begin{align*}
\text{(39)} & \quad \text{a. } [\text{cao}] = \lambda d, \lambda x_e. \text{tall}(x) \geq d \\
                 & \quad \text{b. } [\text{dài}] = \lambda d, \lambda x_e. \text{long}(x) \geq d
\end{align*}
\]

Other predicates need *nhiều* ‘much’ in order to combine with degree expressions. I propose that predicates that always need *nhiều* like *hát* ‘sing’, *ăn* ‘eat’, and *sành viền* ‘student’ have typical denotations like those in (40), as predicates of type <e,t> or <e,e,t>.
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What about the predicates that combine with *nhiều* in some cases but not others, predicates like *vui* ‘happy’ and *dep* ‘beautiful’ for consultant NPD, and *thích* ‘like’ and *ghét* ‘hate’? These are like the predicates in (40) in that they are also unable to combine directly with degree expressions, but I propose that these are measure functions (Kennedy, 1997; Svenonius and Kennedy, 2006) of type <e,d> or <e,ed> (41). These predicates take in an entity and return the degree to which that entity embodies the predicate, rather than returning a truth value.

(41)  a.  \[vui_{[M]} = \lambda x.e.x \text{sings} \]
    b.  \[đẹp_{[M]} = \lambda x.e.\text{beautiful}(x) \]
    c.  \[\text{thích} = \lambda x.e.\text{like}(x)(y) \]
    d.  \[\text{ghét} = \lambda x.e.\text{hate}(x)(y) \]

Speakers like consultant PK who reject *vui* ‘happy’ and *dep* ‘beautiful’ with *nhiều* presumably analyze these as <d,et> functions that combine directly with degree expressions (42). The two versions of these predicates are distinguished with the diacritics M (measure) and R (relation).

(42)  a.  \[vui_{[R]} = \lambda d.e.\text{happy}(x) \geq d \]
    b.  \[\text{dep}_{[R]} = \lambda d.e.\text{beautiful}(x) \geq d \]

With all of these pieces in place, this leaves the question of how the non-<d,et> predicates compose with degree expressions. Following Bresnan (1973), Svenonius and Kennedy (2006), Grano and Kennedy (2012), and Wellwood (2012) (among others), I propose that an extra morpheme must mediate between these predicates and degree expressions. This morpheme is often realized overtly as *nhiều* ‘much, many’. For the <e,d> and <e,ed> predicates, *nhiều* comes in two versions: the overt version that is now quite familiar (*nhiều<sub>[M]</sub>*), and a silent version, which I will label \(\mu\), following the label used by Grano and Kennedy (2012) for the functionally similar silent morpheme that they posit. For the <e,t> and <e,et> predicates, I propose that these also combine with *nhiều*, albeit a version with a slightly different denotation. There is no silent counterpart \(\mu\) for this version of *nhiều*, which I will label *nhiều<sub>[ET]</sub>* because it takes in <e,t> arguments. One can conceptualize these lexical items as being something like applicatives for degrees, introducing a degree argument to a predicate that does not have one by default. Denotations for *nhiều<sub>[M]</sub>*/\(\mu\) and *nhiều<sub>[ET]</sub>* are provided in (43).

(43)  a.  \[\text{[nhiều<sub>[M]</sub>]/[\mu]} = \lambda d.e.\text{G}_{<e,d>}\cdot \lambda x.e.\text{G}(x) \geq d \]
    b.  \[\text{[nhiều<sub>[ET]</sub>]} = \lambda d.e.\text{F}_{<e,t>}\cdot \lambda x.e.\text{F}(x) \& \text{Meas}(\text{F}(x)) \geq d \]

(43b) contains a function Meas. What is Meas? It is a function that takes in a predicate and returns a degree based on the most salient scale on which that predicate can be measured. For (plural) count nouns this is cardinality; for a verb like ‘run’ it may be distance or time. Due to space and scope limitations, I do not elaborate on the nature of Meas in this paper. The important thing is that it converts an <e,t> predicate into a degree on a scale. This denotation for *nhiều<sub>[ET]</sub>* is loosely based on a semantically similar operator discussed in Rett (2018).

Finally, a denotation for *rất* ‘very’ is provided in (44). The truth conditions of *rất* are such that the maximum degree to which an individual embodies a predicate \(Q\) is much greater (\(\gg\)) than the contextual standard for an individual to embody that predicate (Stnd\(_Q\)), an idea loosely based on Katz (2005). It is perhaps a bit strange to treat *rất* as a degree quantifier like *hơn* ‘exceed’, but this allows for a uniform denotation for *rất* despite the differences in the semantic types of predicates and the fact that some predicates combine with *nhiều*/\(\mu\) ‘much’.

(44)  \[\text{[rất]} = \lambda Q_{<e,d>}\cdot \text{max}(Q) \gg \text{Stnd}_Q \]
5.2. Proposal part 2: Vietnamese comparative deletion

The differences described above in how predicates combine with degree expressions interact with a mandatory deletion operation in the standards of comparatives. This deletion operation is licensed by OP, the \textit{wh}-element that undergoes degree abstraction in standards to create a $<d,t>$ argument for -er/hơn. OP has the features shown in (45); it is a Deg head of type $d$, $+wh$ but not used in questions ($-Q$). The $+wh$ feature puts OP in line with its overt instantiation found in some English dialects (Chomsky, 1977: 87) and other languages (Beck et al., 2009: 43-44), and the $-Q$ feature distinguishes it from the Deg head used in degree questions. The crucial feature is the ellipsis (E) feature (Merchant, 2008), which allows OP to license ellipsis of its complement. The E feature is always present, so OP always forces ellipsis.

(45) \begin{align*}
\text{OP} &= [\text{Deg}, d, +wh, -Q, E]
\end{align*}

I propose the structures in (46) for combinations of Deg, VP or NP, and \textit{m\u0103}/\textit{mây} ‘much’ in the standards of comparatives. The idea that a word like \textit{much} mediates the relation between a predicate and degree phrase has been suggested before by Bresnan (1973) and Wellwood (2012). Grano and Kennedy (2012) suggest something similar, but with a different syntax.

(46) \begin{align*}
\text{a.} & \quad \text{DegP}_{<e,t>} \\
& \quad \text{Deg}_{d} \quad \text{VP}_{<e,t>} \\
& \quad \text{V}_{<e,t>} \\
& \quad \text{tall} \\
\text{b.} & \quad \text{DP}_{e} \\
& \quad \text{D}_{<e,t>} \quad \text{NP}_{<e,t>} \\
\text{c.} & \quad \text{VP}_{<e,t>} \\
& \quad \text{V}_{<e,t>} \\
& \quad \text{sing} \\
\text{d.} & \quad \text{VP}_{<e,t>} \\
& \quad \text{V}_{<e,t>} \\
& \quad \text{thích} \\
& \quad \text{like} \\
& \quad \text{toán} \\
& \quad \text{math} \\
& \quad \text{Deg}_{d} \quad \text{MuchP}_{<e,t,d>} \\
& \quad \text{Many}_{<d,t,e,d>} \\
& \quad \text{mu}/\text{mây}_{<M,J>} \quad \text{much} \\
\end{align*}

These structures represent a small but syntactically significant departure from the structure in (18). There, the gradable predicates take DegP as an argument. In these structures, partly inspired by Kennedy (1997), Deg serves as a head that takes gradable predicates and \textit{m\u0103}/\textit{mây} ‘much’ as arguments. The change in syntactic structure does not affect the semantics. Despite the difference in headedness, the order in which the constituents combine remains the same.

Deg takes whatever it combines with first as its complement, and this allows us to capture the contrasts in the behavior of different predicates. In some structures, like (46a) with \textit{cao} ‘tall’, Deg is able to combine directly with the predicate. Thus, the predicate is Deg’s complement, and the mandatory deletion operation applies to this predicate (shown via the strikeout of $\text{VP}$).
Deleting this predicate is acceptable if it is identical to an antecedent in the matrix clause syntactically and semantically (*-given in the terminology of Merchant, 2008). If this predicate is not identical to an antecedent in the matrix clause, as in a subcomparative, then it cannot be elided. This creates a conflict with the mandatory deletion operation, causing a crash.

By contrast, predicates like sinh viên ‘student’ (46b), hát ‘sing’ (46c), and thích ‘like’ (46d) do not combine directly with Deg, so Deg combines instead with a MuchP headed by nhiều/mu ‘much’. Thus, MuchP, rather than VP or NP, is the complement of Deg. Deg only forces its complement to elide, so MuchP must elide, but the predicate can remain. Under this account, the variation in the possibility of subcomparatives with predicates like đẹp ‘beautiful’ is the result of some speakers treating it as a <d,et> predicate that combines directly with Deg (47a) and other speakers having nhiều/mu in the structure (47b). đẹp must elide if it is the complement of Deg, ruling out subcomparatives, but it may remain if nieuwe/mu is the complement of Deg.

(47) a.  
\[ \text{Deg}_d \text{OP[E]} \text{VP}_{<e,et>} \]
\[ \text{V}_{<e,et>} \]
\[ \text{đẹp}_{dR} \text{beautiful} \]

b.  
\[ \text{VP}_{<e,et>} \text{DegP}_{<ed,et>} \]
\[ \text{V}_{<e,et>} \text{đẹp}_{dM} \text{beautiful} \]
\[ \text{MostP}_{<d,et>} \text{mu/nhiều}_{dM} \text{much} \]

5.3. The nominalization repair for ungrammatical subcomparatives

Attributing the mandatory deletion operation to an ellipsis (E) feature on the Deg head OP leads to a straightforward account of why nominalizing (at least) the predicate in the standard is a possible repair for ungrammatical subcomparatives. As a preliminary, an ungrammatical subcomparative and a possible repair are provided in (29), repeated as (48).

1SG tall exc. car long  
Int. ‘I’m taller than the car is long.’  
(*NPD/PK)

b.  Tôi cao hơn chiều dài của xe hơi.  
1SG tall exc. direction long of car  
‘I’m taller than the length of the car.’  
(✓NPD)

Interestingly, nominalizing predicates is also the repair strategy to express the meanings of subcomparatives in languages without degree abstraction like Mandarin (Erlewine, 2018) and Luganda (Bochnak, 2018). This suggests that nominalization allows one to avoid degree abstraction. Of course, Vietnamese has degree abstraction, so it does not need this repair for the same reason, at least not directly. However, because nominalization avoids degree abstraction, it also avoids OP. If OP is absent, then it will not force elision of gradable predicates.

I follow Bochnak (2018) in attributing a type-shifting role to the morphemes that nominalize gradable predicates. More specifically, a word like chiều ‘direction’ takes in a <d,et> predicate and converts it into an <e,dt> one (49). The nominalized predicate (type <e,dt>) then combines with the entity to which its property applies, resulting in a nominalization of type <d,t> appro-
appropriate for composition with *hơn* ‘exceed’. A \(<d,t>\) predicate is derived in the standard without the need for degree abstraction and thus without the need for OP. This is illustrated in (50).

\[(49) \quad [\text{chiều}] = \lambda G_{<d,t>} \cdot \lambda x.e.\lambda d.d.G(x) \geq d\]

\[(50)\]

The nominalization repair highlights the role of OP in licensing the mandatory deletion operation in Vietnamese. The matrix Deg head *hơn* ‘exceed’ does not force elision of its complement (the standard). It is also not the case that certain predicates are inherently incompatible with remaining in the standards of comparatives. Rather, predicates that combine directly with Deg can serve as complements of OP, making them potential targets for deletion. Other predicates avoid deletion due to their inability to combine directly with Deg and serve as complements of OP, but predicates that combine directly with Deg can only avoid deletion if OP is absent. Nominalization of the standard resolves this issue by removing OP from the structure.

6. Conclusion

This paper began with a presentation of different degree constructions in Vietnamese to show that the language has clausal standards, has degrees in its semantics (+DSP), has degree abstraction (+DAP), and allows gradable predicates to co-occur overtly with degree expressions (+DegPP). Next it showed that despite these parameter settings and the possibility of clausal standards, many subcomparatives are ungrammatical, though some are possible, subject in some cases to speaker variation. After that it discussed nominal comparatives, comparatives with non-stative verbs, and patterns of intensification with *rất* ‘very’ and *rất nhiều* ‘very much’ to show that the possibility of remaining in the standard of a comparative is connected to the possibility of interacting with *nhiều* ‘much’ in these constructions. This led to an analysis that accounts for variation among predicates with regards to their permissibility in subcomparatives by positing that some predicates combine directly with degrees as complements of Deg, while in other cases Deg must first combine with a MuchP complement headed by *nhiều* or its silent
counterpart \( \mu \) before combining with a predicate. Vietnamese comparative deletion, licensed by the Deg head OP, forces the complement of OP to elide in the standards of comparatives, allowing predicates to remain only when they do not serve as complements of OP.

So what are the major take-aways from this analysis? First, the availability of subcomparatives in a language does not follow purely from having clausal standards and +DSP, +DAP, and +DegPP parameter settings. In addition to these factors, comparative deletion must not force gradable predicates to elide. Second, a single language may manifest multiple strategies for combining predicates with degrees, even among predicates that seem to belong to the same syntactic category. Vietnamese exhibits three classes of predicates regarding their semantics and their interaction with degrees: 1. predicates that combine directly with degrees (<d,et>), 2. predicates that are gradable but cannot combine directly with degrees (<e,d>|<e,ed>), and 3. predicates that are not (inherently) gradable and also cannot combine directly with degrees (<e,t>|<e,et>). These differences result in crucial structural differences that interact with comparative deletion, affecting whether or not a particular predicate is possible in subcomparatives.

This analysis raises the question of why +DSP/+DAP/+DegPP languages with clausal standards, like English, generally allow subcomparatives without exhibiting the differences between predicates seen in Vietnamese. This analysis suggests two possibilities: 1. All the gradable predicates in languages that tolerate all subcomparatives are measure functions (type <e,d> or <e,ed>). These predicates always combine with an element like much/\( \mu \) (Bresnan, 1973; Wellwood, 2012). Because much/\( \mu \) always mediates the relationship between these predicates and degrees, these predicates never serve as complements of OP. Though elements that combine directly with OP may be forced to elide in standards, like much in English nominal comparatives, predicates are only subject to more general preferences against repeating material. +DSP/+DAP/+DegPP languages with clausal standards that accept no subcomparatives at all only have gradable predicates that combine directly with degrees (type <d,et>). Vietnamese is atypical in that it mixes predicate types. 2. Comparative deletion in English-like languages does not target gradable predicates, either because Deg does not force its complements to elide, or because Deg does not take these predicates as complements. Perhaps OP has an E feature in some languages and lacks it in others. Alternatively, languages vary in whether Deg takes gradable predicates, with or without much/\( \mu \), as complements, or whether predicates take DegP arguments. I leave the exploration of these possibilities to future work.

References


A propositionalist semantics for imagination and depiction reports
Kristina LIEFKE — Goethe University Frankfurt

Abstract. We present a formal semantics for physical and mental depiction reports (e.g. *Penny is painting a penguin, Uli is imagining a unicorn*) that interprets the complements of these reports as propositionally coded situations. Our semantics improves upon Zimmermann’s (2016) property-based semantics for such reports (see Zimmermann, 1993) by blocking unwarranted inferences to a common objective and by capturing the semantic interaction of DPs and CPs in depiction complements. At the same time, it preserves the merits of Zimmermann’s semantics, especially the compositional interpretation of depiction reports and the ability to account for missing *de dicto*-readings of reports with a strong quantificational object DP. Our semantics shows that – contrary to the received view (e.g. Forbes, 2006; Zimmermann, 2016) – depiction complements are not evidence against a propositionalist analysis of attitude complements.

Keywords: depiction reports, property-based semantics, situation semantics, missing *de dicto*-readings, inference to a common objective, semantic DP/CP interaction.

1. Introduction

Depiction reports are representational readings of reports like (1a) and (2a) whose complements describe the content of pictures or mental images (see Zimmermann, 2016: 430–431; cf. Forbes, 2006: Ch. 7; Moltmann, 1997). On the representational reading of (1a), the object DP *a penguin* partially describes the content of Penny’s painting (see (1b)); on the relevant reading of (2a), the DP *a unicorn* partially describes the content of Uli’s mental image (see (2b)):

(1) a. Penny is painting (/drawing/scultping) \([dpa\text{ penguin}]\)
   \(\equiv\) b. Penny is pictorially (/plastically) representing a penguin

(2) a. Uli is imagining (/visualizing/envisioning) \([dp\text{ a unicorn}]\)
   \(\equiv\) b. Uli is mentally depicting a unicorn

Depiction reports pose a special challenge for the formal interpretation of natural language. This challenge is reflected in the inability of existing semantics (see Zimmermann, 1993, 2006, 2016; Moltmann, 1997) to account for all of the following semantic properties of these reports:

Property (i): missing *de dicto*-readings. Depiction reports with an indefinite object DP (e.g. (1a), copied in (3)) are ambiguous between a specific/de re-reading (on which the DP takes wide scope with respect to the depiction verb; see (3b)) and a non-specific/de dicto-reading

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2We follow Zimmermann (2016) in excluding, from this class, creation readings (cf. Dowty, 1977; see the reading of (1a) in (3a)). The latter are readings that describe the physical object produced in an act of depiction.

(3) a. Penny is painting a picture (with a penguin in it)
   b. Penny is pictorially representing a penguin

We deviate from Zimmermann (2016) in assuming that representational readings also include specific/de re-readings (i.e. Zimmermann’s *portrait readings*; see Goodman, 1969). The specific reading of (1a) is given in (3b).
of the indefinite (on which the DP takes narrow scope with respect to this verb; see (3a)) (see Zimmermann, 2016: 428–430; cf. Zimmermann, 1993: 149–152):

(3) Penny is painting \[\text{DP a penguin}\]
   a. non-specific: Penny is painting some penguin, but no particular one
      \(\equiv\) Penny is painting a penguin picture
   b. specific: There is a particular penguin that Penny is painting
      \(\equiv\) Penny is painting a penguin portrait

In contrast to the above, depiction reports with a strong quantificational object DP (e.g. (4)) only have a specific reading (here: (4b)). For such reports, the non-specific reading (cf. (4a)) is not available (see Zimmermann, 1993: 160–161).

(4) Penny is painting \[\text{DP every penguin}\]
   a. non-specific: ??Penny is painting all penguins, whichever they are
   b. specific: For each particular penguin in a given domain, Penny is painting it

Property (ii): no inferences to a common objective. Depiction reports allow existential quantification over their non-specific objects (e.g. (5); see Zimmermann, 2006: 718–720, 725–726) and allow inferences that are based on the upward monotonicity of their complement (e.g. (6); see \textit{ibid.}: 726, 730):

(5) a. Uli is imagining \[\text{DP a (non-specific) unicorn}\]
   \(\Rightarrow\) b. There is \[\text{DP some (non-specific) thing}\] (viz. some unicorn) that Uli is imagining

(6) a. Uli is imagining \[\text{DP a (non-specific) unicorn}\] b. All unicorns are things (= objects)
   \(\Rightarrow\) c. Uli is imagining \[\text{DP some (non-specific) thing}\]

The above properties notwithstanding, depiction reports intuitively block inferences to a common objective (e.g. (7); see Zimmermann, 2006: 730–731):

(7) a. Uli is imagining \[\text{DP some (non-specific) thing}, \text{viz. some unicorn}\]
   \(\Rightarrow\) b. Ede is imagining \[\text{DP some (non-specific) thing}, \text{viz. some griffin}\]
   \(\Rightarrow\) c. There is \[\text{DP some (non-specific) thing}\] that Uli and Ede are imagining
      \(\equiv\) Uli and Ede are imagining the same (non-specific) thing

Property (iii): DP/CP interaction. Depiction verbs license DP and (certain kinds of)\(^3\) CP complements (see (8)) and witness the semantic interaction of DPs and CPs in their complements (see Liefke and Werning, 2018: 644–648; Liefke, 2019). This interaction is evidenced by the possibility of coordinating DPs with finite CPs in depiction complements\(^4\) (see (9a))

\(^3\)In particular, some depiction verbs (incl. \textit{paint}) do not accept that-clause complements (see (*)):

\(\star\) *Penny is painting \[\text{CP-\textsc{fin} that a penguin is diving into the sea}\]

\(^4\)Notably, most depiction verbs also license non-finite complements (incl. gerund complements). For reasons of scope, we defer the treatment of gerund-taking occurrences of depiction verbs to another paper (viz. Liefke, 2019).

\(^5\)Such coordinations are well-attested, as is shown by the following examples: \textit{imagine a black television screen}
and of specifying the DP through a finite CP in these complements (see (9b); cf. Liefke and Werning, 2018: 647–648).

(8)  a. Uli is imagining \( [\text{DP} \, \text{a unicorn}] \)
    b. Uli is imagining \([\text{CP} \, \text{that a unicorn is basking in the sun}]\)

(9)  a. Uli is imagining \([\text{DP} \, \text{a unicorn}] \) and \([\text{CP} \, \text{that it is basking in the sun}]\)
    b. Uli is imagining \([\text{DP} \, \text{a unicorn}]\), in particular, \([\text{CP} \, \text{that it is basking in the sun}]\)

This paper provides an alternative semantics for depiction reports that adequately captures the above properties. The paper is organized as follows: to show the semantic challenges that are posed by these properties, we first describe existing semantics for depiction reports and identify their shortcomings (in Section 2). We then present our alternative semantics for depiction reports (in Section 3) and show that this semantics avoids these shortcomings (in Section 4). The paper closes by discussing the relevance of our semantics for the recent debate about propositionalism (i.e. the view that all intensional constructions can be interpreted as cases of truth-evaluable, clausal embedding).

2. Existing Semantics and Their Challenges

Current semantics for depiction reports fall in one of two classes: traditional accounts (e.g. Moltmann, 1997) follow Montague\(^6\) (1970: 394 ff.) in interpreting the complements of depiction verbs as \textit{intensional generalized quantifiers} (i.e. as type-\(\{s, \langle\langle s, \langle e, t \rangle \rangle, t \rangle \}\) functions from an index to a set of properties that are jointly exemplified at this index). Modern accounts (see Zimmermann, 1993, 2016; cf. Van Geenhoven and McNally, 2005; Schwarz, 2006; Deal, 2008) interpret depiction complements instead as \textit{properties} of individuals (type \(\langle s, \langle e, t \rangle \rangle\)).

A streamlined variant of the traditional, Montague-style, semantics for \textit{paint} is given in (10), where \textit{paint} is a non-logical constant of type \(\langle s, \langle\langle s, \langle e, t \rangle \rangle, t \rangle \}, \langle e, t \rangle \}\rangle\). (For better readability, the type of the complement is printed in boldface.)\(^8\) To distinguish the Montague-style interpretation of depiction reports from Zimmermann’s (1993, 2016) property-based interpretation and \textit{that white light appears} ... (https://tinyurl.com/y7pjqdzk, accessed April 27, 2019) and \textit{imagine a very large arena} and \textit{that the thousands of cubic feet of space inside that arena represent eternity} (https://tinyurl.com/ybhzy12q, accessed April 27, 2019).

\(^6\)Montague’s original semantics is restricted to the interpretation of the intensional transitive verbs [ITVs] \textit{seek, conceive, worship,} and \textit{owe}. However, since depiction verbs show the same intensional behavior as ITVs (see Zimmermann, 1993: 151), we assume with Zimmermann (2006, 2016) that they admit of the same analysis.

\(^7\)Following Quine (1956), Montague has also proposed an alternative semantics for ITVs (see Montague, 1969: 174–177) that decomposes these verbs into clause-taking constructions. Such decompositions include the analysis of \textit{seek} as \textit{try to find}, where the complement of \textit{try} denotes a proposition. However, since many depiction verbs do not have a straightforward lexical decomposition, we here focus on the interpretation of depiction complements as intensional quantifiers. We will return to the propositional interpretation of depiction complements in Section 4.4.

\(^8\)In what follows, we use a partial variant of Gallin’s type logic \(\mathcal{TY}\) with basic types \(e\) (for individuals), \(s\) (for indices/situations), and \(t\) (for truth-combinations). We adopt Montague’s notation for function types: \(\langle \alpha, \beta \rangle\) is the type for (partial) functions from objects of type \(\alpha\) to objects of type \(\beta\). Below, we follow the convention that a function’s simultaneous application to a sequence of arguments indicates successive application in the reverse order of the arguments (‘Currying’). We adopt the following typing convention for variables: \(x, y, z, u, v\) and \(i, j, k, l\) are individual resp. situation variables, where \(i\) denotes the default point of evaluation. \(P, P', Q\) and \(T, T'\) are variables over type-\(\langle s, \langle e, t \rangle \rangle\) resp. type-\(\langle s, \langle \langle s, \langle e, t \rangle \rangle, t \rangle \rangle\) properties. \(\mathcal{P}\) and \(\mathcal{Q}\) are variables over type-\(\langle s, (\langle s, \langle e, t \rangle \rangle, t) \rangle\) quantifiers. \(\Sigma\) and \(\Pi\) are variables over quantifier-properties (type \(\langle s, (\langle s, \langle s, \langle e, t \rangle \rangle, t) \rangle, t \rangle\)\).
and from our own interpretation (in Section 3–4), we hereafter annotate semantic brackets with the superscript ‘MS’ to indicate a Montague-style interpretation. The superscript ‘PS’ indicates a property-based interpretation. Absence of a superscript indicates our own interpretation.

\[
\text{MS}\left[paint-DP\right]^i = \lambda \mathcal{D} \lambda z[paint_i(z, \mathcal{D})]
\]

The Montague-style interpretation in (10) assumes that transitive occurrences of depiction verbs (here: \textit{paint}) denote a relation between an index (above: \(i\)), an individual (i.e. the depicting agent, \(z\)), and an intensional quantifier (i.e. a representation, \(\mathcal{Q}\), of the depicted content). The interpretation of the non-specific reading of (1a) is given in (11a). The specific interpretation of (1a) (in (11b)) is obtained by raising the quantifier above the verb:

\[
\begin{align*}
\text{a. MS}\left[(1a)\right]_\text{non-specific}^i = & \quad paint'_i(\text{penny}, \lambda j \lambda P \exists x. penguin_j(x) \land P_j(x)) \\
\text{b. MS}\left[(1a)\right]_\text{specific}^i = & \quad \text{MS}\left[[\text{a penguin}] [\lambda t_1 [\text{Penny is painting } t_1]]\right]_j^i \\
& \quad = (\exists x)[penguin_i(x) \land paint'_i(\text{penny}, \lambda j \lambda P. P_j(x))]
\end{align*}
\]

In contrast to the above, Zimmermann’s (1993, 2016) semantics interprets the indefinite objects of depiction verbs as the properties that are denoted by the restrictor nouns of these objects (see the property-based interpretation of \textit{paint} in (13)). In Zimmermann’s (1993) dynamic semantic system, these properties are identified with the standard DRT-interpretation of indefinites (type \(\langle s, \langle e, t \rangle \rangle\)). Zimmermann (1993) hence assigns \textit{paint} the interpretation in (12), where \textit{paint} is a non-logical constant of type \(\langle s, \langle \langle s, \langle e, t \rangle \rangle \rangle \rangle\):

\[
\text{PS}\left[paint-DP\right]^i_{\text{original}} = \lambda P \lambda z[paint_i(z, P)]
\]

To stay as close as possible to Montagovian semantics, we hereafter replace (12) by de Swart’s reconstruction from (de Swart, 2000) (in (13)). In this reconstruction, \(BE := \lambda \mathcal{D} \lambda j \lambda x[\mathcal{D}_j(\lambda k \lambda y. y = x)]\) is an intensional version of the identically named type-shifter from (Partee, 1987).

\[
\text{PS}\left[paint-DP\right]^i = \lambda \mathcal{D} \lambda z[paint_i(z, BE(\mathcal{D}))] \\
\equiv \lambda \mathcal{D} \lambda z[paint_i(z, \lambda j \lambda x[\mathcal{D}_j(\lambda k \lambda y. y = x)])]
\]

The property-based interpretations of the different readings of (1a) are given in (14):

\[
\begin{align*}
\text{a. PS}\left[(1a)\right]_\text{non-specific}^i = & \quad paint'_i(\text{penny}, \lambda j \lambda y \exists x. penguin_j(x) \land y = x) \\
& \equiv paint'_i(\text{penny}, \text{penguin}) \\
\text{b. PS}\left[(1a)\right]_\text{specific}^i = & \quad (\exists x)[penguin_i(x) \land paint'_i(\text{penny}, \lambda j \lambda y. y = x)]
\end{align*}
\]

This completes our presentation of existing semantics for depiction reports. We now turn to the shortcomings of these semantics. We will see that Properties (ii) and (iii) pose a challenge for both Montague- and property-style semantics. Property (i) is problematic only for the former.

**Challenge (i): capturing missing \textit{de dicto}-readings**

We have seen above that Montague-style semantics interprets depiction verbs as relations to an intensional quantifier (incl. universal quantifiers). The same-type interpretation of referential and quantificational DPs in this semantics (here: \textit{a penguin} and \textit{every penguin}) then enables the interpretation of the specific and the non-specific reading of (4) as (15b) resp. (15a):
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The above interpretation of (4) is fully analogous to the interpretation of (1a) in (11). However, as a result of this analogy, Montague-style semantics wrongly predicts the availability of the non-specific reading, i.e. (4a), of (4).

Property-based semantics blocks the non-specific interpretation of (4) by assuming that *paint* presupposes that its semantic complement is the property-correspondent of an existential quantifier. Such correspondents result from applying *BE* to a quantifier of the form \( \lambda j \lambda y \forall x. \text{penguin}_j(x) \rightarrow P_j(x) \), where \( B \) is a non-logical constant of type \( \langle s, \langle e, t \rangle \rangle \). Since \( \text{BE}(\llbracket \text{every penguin} \rrbracket) (= \lambda j \lambda y \forall x. \text{penguin}_j(x) \rightarrow x = y; \text{see (16a)\text{ is not} the property-correspondent of an existential quantifier, *paint* \text{is undefined for this property. This explains the non-availability of the non-specific reading of (4). Since \text{BE}(\llbracket \text{LIFT}(\llbracket t \rrbracket)) (= \lambda j \lambda y. x = y; \text{see (16b)}\text{ is the property-correspondent of an existential quantifier (viz. of the quantifier \( \lambda j \lambda P(\exists y)[y = x \land P_j(y)] \), *paint* \text{is still defined for} \( \lambda j \lambda y. x = y \). This explains the availability of the specific reading, i.e. (4b), of (4).

\[
\begin{align*}
\text{a. } & \text{MS}[[4]]_\text{non-specific} = \text{paint}_i(penny, \lambda j \lambda P \forall x. \text{penguin}_j(x) \rightarrow P_j(x)) \quad (??) \\
\text{b. } & \text{MS}[[4]]_\text{specific} \equiv (\forall x)[\text{penguin}_i(x) \rightarrow \text{paint}_i(penny, \lambda j \lambda P. P_j(x))] \\
\text{The above interpretation of (4) is fully analogous to the interpretation of (1a) in (11). However, as a result of this analogy, Montague-style semantics wrongly predicts the availability of the non-specific reading, i.e. (4a), of (4).}
\end{align*}
\]

**Challenge (ii): blocking inferences to a common objective**

We have shown above that Montague- and property-style semantics allow for the non-specific interpretation of indefinite DPs in depiction complements (see (11a), (14a)). To validate the upward monotonicity inference in (6), Zimmermann assumes (for MS) that the depicting agent stands in the depiction relation to all intensional quantifiers whose restrictor properties are more general than the restrictor of the quantifier to whom the agent has been established to stand in this relation.\(^9\) This assumption takes the form of a condition on admissible models. In Zimmermann’s specification of this condition (in (17a); see Zimmermann, 2006: 722), ‘\( P \subseteq Q \) (\( :=(\forall j)(\forall x)[P_j(x) \rightarrow Q_j(x)] \)) asserts that \( Q \) is a more general property than \( P \); \( \exists P \) and \( \exists Q \) are existential quantifiers that are restricted by the properties \( P \) and \( Q \), respectively. The PS-counterpart of Zimmermann’s condition is given in (17b):

\[
\begin{align*}
\text{a. } & \text{for MS: } (\forall P)(\forall Q)(\forall z)[P \subseteq Q \rightarrow (\text{imagine}_i(z, \exists P) \rightarrow \text{imagine}_i(z, \exists Q))] \\
\text{b. } & \text{for PS: } (\forall P)(\forall Q)(\forall z)[P \subseteq Q \rightarrow (\text{imagine}_i(z, P) \rightarrow \text{imagine}_i(z, Q))] \\
\end{align*}
\]

The greater generality of the property ‘being a/some thing’ than the property ‘being a unicorn’, i.e. \( \text{unicorn} \subseteq (\lambda j \lambda y. y = y) \), then supports the validity of the monotonicity inference in (6) (see (19) resp. (20)). The interpretation of (6c) as (19c) (in MS), respectively as (20c) (in PS) is enabled by the familiar, lower-order (LO), interpretation of the DP *something* (in (18)).

\(^9\)Zimmermann (2006: 2–725) derives this condition by combining a Quinean lexical-decomposition account of opacity (see Quine, 1956) with a Hintikka-style approach to propositional attitudes (see Hintikka, 1969). However, since we do not (yet) want to commit to a propositionalist analysis of depiction reports, we adopt (17a) resp. (17b) directly. We will see in Section 4.2 that depiction reports, in fact, allow for a propositionalist analysis.
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The above interpretations already provide the semantics for the premises of (5) (i.e. (19a)/(20a)) and (7) (i.e. (19c)/(20c)). To interpret the conclusion of (5) resp. (7), Zimmermann (2006: 727) assumes that *something* is ambiguous between the familiar lower-order reading *something* (on which it quantifies over specific objects; see (18)) and a higher-order reading *something* (on which it quantifies over non-specific objects, represented by intensional quantifiers; s. (21)):

\[
\begin{align*}
\text{(18) } & \quad \text{a. } [\text{thing}_{LO}] = \lambda j \lambda y. y = y \quad \text{b. } [\text{some}_{LO}] = [a_{LO}] = \lambda Q \lambda j \lambda P (\exists x)[Q_j(x) \land P_j(x)] \\
& \quad \frac{\text{b. } [\text{something}_{LO}] = [a/\text{something}_{LO}][\text{thing}_{LO}]}{= \lambda Q \lambda j \lambda P (\exists x)[Q_j(x) \land P_j(x)](\lambda k \lambda y. y = y) = \lambda j \lambda P (\exists x)[x = x \land P_j(x)]} = \lambda j \lambda P (\exists x)[P_j(y)] \\
\end{align*}
\]

\[
\begin{align*}
\text{(19) } & \quad \text{a. } \text{MS}[(6a)]^i = \text{imagine}_i(\text{uli.} \lambda j \lambda P \exists x. \text{unicorn}(x) \land P_j(x)) \\
& \quad \frac{\text{b. } (17a) \quad \text{& } \text{unicorn} \subseteq (\lambda j \lambda y. y = y)}{\Rightarrow \text{c. } \text{MS}[(6c)]^i = \text{MS}[\text{Uli is imagining } [dp \text{some-thing}_{LO}]]^i \quad \text{(by (17a))}} = \text{imagine}_i(\text{uli.} \lambda j \lambda P \exists x. \text{P}_j(x)) \\
\end{align*}
\]

\[
\begin{align*}
\text{(20) } & \quad \text{a. } \text{PS}[(6a)]^i = \text{PS}[\text{Uli is imagining } [dp \text{a unicorn}_{LO}]]^i = \text{imagine}_i(\text{uli.} \text{unicorn}) \\
& \quad \frac{\text{b. } (17b) \quad \text{& } \text{unicorn} \subseteq (\lambda j \lambda y. y = y)}{\Rightarrow \text{c. } \text{PS}[(6c)]^i = \text{PS}[\text{Uli is imagining } [dp \text{some-thing}_{LO}]]^i \quad \text{(by (17b))}} = \text{imagine}_i(\text{uli.} \lambda j \lambda y. y = y) \\
\end{align*}
\]

The property-based interpretation of (5b) and (7c) (in (22) resp. (23)) can be obtained by using a property-version of the non-specific higher-order reading of *something*, along the lines of (Zimmermann, 2006: 732). This reading results from interpreting the occurrence of *something* in (5b) and (7c) as *some* (\(\uparrow \text{thing}_{LO}\))” (see (25)), where \(\uparrow\) is an intensional variant of the identically named type-shifter from (Zimmermann, 2006: 733, (41)):

\[
\text{(24) } \uparrow := \lambda P' \lambda j \lambda \mathcal{Q} (\exists P)[\mathcal{Q} = (\lambda k \lambda Q \exists y. P'_k(y) \land P_k(y) \land Q_k(y))] 
\]
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(25) \[ \text{[some}_{\text{HO}}(\uparrow (\exists \text{thing}_{\text{LO}}))] \]
\[ = \lambda \Sigma \lambda j \lambda \Pi (\exists \mathcal{D})[\Sigma_j(\mathcal{D}) \land \Pi_j(\mathcal{D})](\lambda j \lambda \mathcal{P} (\exists \mathcal{P})[\mathcal{P} = \lambda k \lambda Q \exists y. P_k(y) \land Q_k(y)]) \]
\[ = \lambda j \lambda \Pi (\exists \mathcal{P})[\Pi_j(\lambda k \lambda Q \exists y. (P_k(y) \land Q_k(y)))] \]

The above enables the property-based interpretation of (5b) and (7c) as follows:

(26) \[ \text{PS}[5b]i = \text{PS}[\text{[some}_{\text{HO}}(\uparrow \text{thing}_{\text{LO}})] [\lambda 1 [\text{Uli is imagining } \mathcal{T}_1]]^i \]
\[ = \lambda \Pi (\exists \mathcal{P})[\Pi_j(\lambda j \lambda Q \exists u. P_j(u) \land Q_j(u))] \]
\[ \equiv (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } \lambda j \lambda x \exists y. P_j(y) \land y = x)] \equiv (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } P)] \]

(27) \[ \text{PS}[7c]i = \text{PS}[\text{[some}_{\text{HO}}(\uparrow \text{thing}_{\text{LO}})] [\lambda 1 [\text{Uli is imagining } \mathcal{T}_1 \text{ and Ede is imagining } \mathcal{T}_1]]^i \]
\[ = \lambda \Pi (\exists \mathcal{P})[\Pi_j(\lambda j \lambda Q \exists u. P_j(u) \land Q_j(u))] \]
\[ \equiv (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } \lambda j \lambda x \exists \mathcal{D}_1, (\lambda k \lambda y. y = x))] \]

(24) and its Montague-style variant (in (30)) can also be used to interpret the higher-order non-specific reading of (5a) and (7a/b):

(28) \[ \text{PS}[5a]i = \text{PS}[\text{[a}_{\text{HO}}(\uparrow \text{unicorn}_{\text{LO}})] [\lambda 1 [\text{Uli is imagining } \mathcal{T}_1]]^i \]
\[ = (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } \lambda j \lambda x. \text{unicorn}_i(x) \land P_j(x))] \]

(29) \[ \text{PS}[7a]i = \text{PS}[\text{[some}_{\text{HO}}(\uparrow \text{thing}_{\text{LO}})] [\lambda 1 [\text{Uli imagines } \mathcal{T}_1]]^i = (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } P)] \]

(30) \[ \uparrow \mathcal{D} := \lambda P \lambda j \lambda \mathcal{D} [\mathcal{D} = (\lambda k \lambda Q \exists y. P_k(y) \land Q_k(y))] \]

(31) \[ \text{MS}[5a]i = \text{MS}[\text{[a}_{\text{HO}}(\uparrow \mathcal{D} \text{ unicorn}_{\text{LO}})] [\lambda 1 [\text{Uli is imagining } \mathcal{T}_1]]^i \]
\[ = \lambda \Pi (\exists \mathcal{D})[\mathcal{D} = (\lambda k \lambda P \exists y. \text{unicorn}_k(y) \land P_k(y))] \]
\[ \equiv (\exists \mathcal{D})[\text{imagine}_i(\text{Uli, } P) \land \mathcal{D} = (\lambda k \lambda P \exists y. \text{unicorn}_k(y) \land P_k(y))] \]

(32) \[ \text{MS}[7a]i = \text{MS}[\text{[some}_{\text{HO}}(\uparrow \mathcal{D} \text{ thing}_{\text{LO}})] [\lambda 1 [\text{Uli is imagining } \mathcal{T}_1]]^i \]
\[ = (\exists \mathcal{D})[\text{imagine}_i(\text{Uli, } P) \land \mathcal{D} = (\lambda k \lambda P \exists y. P_k(y))] \equiv (\exists \mathcal{D})[\text{imagine}_i(\text{Uli, } P)] \]

The above straightforwardly validates the inference in (5), which now comes out as an instance of higher-order existential weakening (see Zimmermann, 2006: 733):

(33) \[ a. \quad \text{MS}[5a]i = (\exists \mathcal{D})[\text{imagine}_i(\text{Uli, } P) \land \mathcal{D} = (\lambda k \lambda P \exists y. \text{unicorn}_k(y) \land P_k(y))] \]
\[ \Rightarrow b. \quad \text{MS}[5b]i = (\exists \mathcal{D})[\text{imagine}_i(\text{Uli, } P)] \]

(34) \[ a. \quad \text{PS}[5a]i = (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } \lambda j \lambda x. \text{unicorn}_j(x) \land P_j(x))] \]
\[ \Rightarrow b. \quad \text{PS}[5b]i = (\exists \mathcal{P})[\text{imagine}_i(\text{Uli, } P)] \]

However, the above also validates the unwarranted inference in (7). This is due to the fact that Montague- and property-style semantics interpret the DP something in (6c) as the most general abstract object: \( \lambda j \lambda P (\exists x) P_j(x) \) (MS) resp. \( \lambda j \lambda y [y = y] \) (PS). As a result, these semantics assign the same interpretation to the two occurrences of something in (7a) and (7b) (see (35a/b) resp. (36a/b)). This interpretation then serves as a witness for the conclusion in (7c), such that (7) comes out valid. But this is counterintuitive.
One could try to avoid the above problem by interpreting clausal depiction complements instead as type-

property-pairs typically have a different type from properties, this strategy would prevent a uniform-type interpre-

tation of nominal and clausal depiction complements. However, since property-pairs typically have a different type from properties, this strategy would prevent a uniform-type interpretation of nominal and clausal depiction complements.

One could try to avoid the above problem by interpreting clausal depiction complements instead as type-

Challenge (iii): capturing DP/CP interaction

Property-based semantics for depiction reports have traditionally focused on the DP comple-

ments of depiction verbs (see (10), (13)). This focus has distracted researchers’ attention from the difficulty of this semantics to interpret the clausal complements of depiction reports: property-type semantics suggests – but does not explicitly claim – that clausal depiction complements are also interpreted as properties. However, for CPs with multiple non-specific indefinites, this strategy fails\(^\text{10}\) to yield a unique interpretation (see Zimmermann, 2005). For example, this strategy interprets the doubly non-specific reading of (37) as (38a) and/or (38b):\(^\text{11}\)

\[
(37) \quad \text{Uli is imagining } [\text{DP a girl] is riding } [\text{DP a unicorn]}
\]

\[
(38) \quad \begin{align*}
\text{a. } & \text{imagine}_i(\text{uli}, \lambda j x . \text{unicorn}_j(x) \land (\exists y)[\text{girl}_j(y) \land \text{ride}_j(y,x)]) \\
\text{b. } & \text{imagine}_i(\text{uli}, \lambda j y . \text{girl}_j(y) \land (\exists x)[\text{unicorn}_j(x) \land \text{ride}_j(y,x)])
\end{align*}
\]

One could try to avoid the above problem by interpreting clausal depiction complements instead as type-

\(^\text{10}\)This failure can be remedied by interpreting the complement of (37) as a pair of properties. However, since property-pairs typically have a different type from properties, this strategy would prevent a uniform-type interpretation of nominal and clausal depiction complements.

\(^\text{11}\)This interpretation is obtained by adopting a non-clausal semantics for the occurrence of imagine in (38). Such a semantics is given in (‡a). The adoption of a non-clausal approach is motivated, in some detail, in (Liefke, accepted).

\[
(‡) \quad \begin{align*}
\text{a. } & \text{PT([imagine-CP])}^i = \text{PT([imagine-DP VP])}^i = \lambda \partial \lambda P \lambda z [\text{imagine}_i(z, \lambda j x [\partial j(\lambda k y. P_k(y) \land y = x))] \\
\text{b. } & \text{PT-alt([imagine-CP])}^i = \lambda P \lambda z [\text{imagine}_i(z, P)]
\end{align*}
\]

To obtain a unique interpretation of (37) (as \((\times)\), below), one could instead adopt the semantics for CP-taking imagine in (‡b). However, this semantics fails to capture the intuitive truth-conditions of (9a).

\[
(\times) \quad \text{imagine}_i(\text{uli}, \lambda j (\exists x)[\text{unicorn}_j(x) \land (\exists y)[\text{girl}_j(y) \land \text{ride}_j(y,x)])}
\]
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(type \( \langle s, (e, t) \rangle \)) and clausal complements (type \( \langle s, t \rangle \)) disables an easy (i.e. type-shift-free) modelling of DP/CP coordinations like (9a).

Since Montague-style semantics does not abstract over the referents of indefinites, it assigns a single/unique interpretation to CPs with multiple non-specific indefinites. For example, Montague-style semantics assigns to (37) the interpretation in (39):

\[
\text{(39) } \text{imagine}_i(\text{uli}, \lambda j \lambda P \exists x. \text{unicorn}_j(x) \wedge (\exists y. \text{girl}_j(y) \wedge \text{ride}_j(y, x)))
\]

However, because this semantics interprets embedded DPs in a different type from CPs (type \( \langle s, (\langle s, (e, t) \rangle, t) \rangle \) resp. \( \langle s, t \rangle \)), it is still challenged by the coordination data from (9). This challenge is particularly acute since most depiction verbs resist a straightforward lexical decomposition into a clause-taking structure.\(^{12}\) We close this section with a note on the interpretation of depiction reports in the semantics from (Zimmermann, 2006):

2.1. A Note on (Zimmermann, 2006)

Zimmermann (2006) has presented an alternative to the property-based semantics in (Zimmermann, 1993) (below, ‘PS’*) that avoids the challenge from inferences to a common objective. This semantics interprets the non-specific objects of ITVs (incl. depiction verbs; see Zimmermann, 2006: 758–759) as existentially quantified sub-properties of the properties that are denoted by the ITVs’ DP object. The different readings of (1a) are then interpreted as (40):

\[
\begin{align*}
\text{(40) a. } & \text{PS'}[\langle 1a \rangle]^i_{\text{non-specific}} = (\exists P)[P \sqsubseteq \text{penguin} \wedge \text{paint}_i(\text{penny}, P)] \\
\text{b. } & \text{PS'}[\langle 1a \rangle]^i_{\text{specific}} = (\exists x)[\text{penguin}_i(x) \wedge \text{paint}_i(\text{penny}, \lambda j \lambda y. y = x)]
\end{align*}
\]

Zimmermann (2006) blocks inferences to a common objective by allowing the non-specific occurrences of something in (7a)/(7b) to denote different (existentially quantified) sub-properties of the maximally general property \( \lambda j \lambda y. y = y \). This semantics models (7) as (41) (ibid.: 741):

\[
\begin{align*}
\text{(41) a. } & [\langle 7a \rangle]^i = (\exists P)[P \sqsubseteq (\lambda j \lambda y. y = y) \wedge \text{imagine}_i(\text{uli}, P)] \\
\text{b. } & [\langle 7b \rangle]^i = (\exists Q)[Q \sqsubseteq (\lambda j \lambda y. y = y) \wedge \text{imagine}_i(\text{ede}, Q)] \\
\Downarrow & \text{ c. } [\langle 7c \rangle]^i = (\exists P)[\text{imagine}_i(\text{uli}, P) \wedge \text{imagine}_i(\text{ede}, P)]
\end{align*}
\]

The above notwithstanding, Zimmermann’s revised property-based semantics has its own problems. For one thing, the replacement of restrictor-denotations by their more specific sub-properties places overly strong demands on the truth of reports like (42). For example, PS’ counter-intuitively demands that (42) is only true if Harry stands in the admiration and the painting relation to the same sub-property of ‘being a hummingbird’ (see (43)).

\[
\begin{align*}
\text{(42) } \text{Harry } [\text{VP}_{\text{admired and painted}}] \text{ [of a hummingbird]} \\
\text{(43) } [\langle 42 \rangle]^i = (\exists P)[P \sqsubseteq \text{hummingbird} \wedge (\text{admire}_i(harry, P) \wedge \text{paint}_i(harry, P))]
\end{align*}
\]

For another thing, Zimmermann’s account of Property (ii) only answers a proper part of a more general problem. As Zimmermann himself points out (see 2006: 729, fn. 29), higher-order non-

\(^{12}\) We will return to the propositional, clausal interpretation of transitive uses of depiction verbs in Section 4.4.
specific readings like (7c) can also arise in the complement of transparent verbs (e.g. *eat*):

(44) I ate something that you ate, too: a slice of pumpkin pie

Given its restriction to ITVs, Zimmermann’s account is unable to account for such readings. Since Zimmermann himself has, in the meantime, abandoned his (2006) semantics, we exclude it from our further considerations. We expect that our presented semantics has a straightforward application to cases like (44) (see Section 4.3). We leave a proof of this expectation for another occasion.

3. Proposal and Background

We propose to account for Properties (i)–(iii) by replacing properties or intensional quantifiers by propositionally coded situations as the denotations of depiction complements. This move is motivated by the view (defended in Stephenson, 2010 for *imagine*) that nominal occurrences of depiction reports like (1a) and (2a) have a semantic situation- (event-, or state-)argument. For (2a), the existence of such argument is supported by the possibility of modifying the relevant occurrence of *imagine* through modifiers like *vividly* or in \[ADJ\] detail (see (45); cf. Stephenson, 2010: 156) and by the observation that physical and mental images typically do not represent isolated items of information, but informationally richer objects (see Zimmermann, 2016: 433).

(45) a. Uli is *vividly* imagining a unicorn

b. Uli is imagining a unicorn in *vivid/lifelike detail*

Arguably, the identity of the depicted situation depends on the particular manner of depicting (e.g. painting vs. imagining), the depicting agent, and the time of depicting. To capture this dependence, we use a subset selection function, \(f\) (see von Fintel, 1999; cf. Kratzer, 1998). This function chooses a subset from a given set of situations \(\lambda j[\ldots]\) in dependence on a parameter, \(e\), for the described depiction event. This subset then represents the depicted situation, event, or state. Our use of *sets of* situations – rather than of a single situation – is motivated by the observation that – in contrast to visual scenes – depicted situations are often not anchored in a particular world or time (see Pustejovsky, 2016), and by the possibility of representing, or *coding*, non-anchored situations by sets of isomorphic (= qualitatively identical) situations (see Kratzer, 2002: 667; cf. Fine, 1977: 136). For the interpretation of the non-specific reading of (2a), these are situations with different worldly anchors that are inhabited by a/some unicorn that exhibits the same properties in all of these situations. The interpretation of the non-specific reading of (2a) is given in (46). Below, *imagine* is a non-logical constant of type \(\langle s, \langle \langle s,t \rangle, e,t \rangle \rangle\).

(46) \(\lbrack(2a)\rbrack_{\text{non-specific}}^i \equiv \lbrack \text{Uli is imagining }[\text{DP a unicorn}]^i \equiv (\exists e)[\text{imagine}_i(e, \text{uli}, f_e(\lambda j \exists x. \text{unicorn}_j(x)))] \quad \text{Uli’s imagined situation in } i \text{ (coded as a set of situations)}\)

The above suggests that DP-taking occurrences of depiction verbs (here: *paint*) have the semantics in (47). There, \(E\) is a situation-relative existence predicate (see Liefke, 2014: 117 ff.). This predicate applies to an individual and an index to assert the individual’s existence in this index. Our use of \(E\) ensures that the individual referent of the object DP inhabits (all members of the set that represents) the situation selected by \(f\).
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(47) \[\text{paint-DP}^i = \lambda \varnothing \lambda z(\exists e)[\text{paint}_i(e, z, f_e(\lambda j. \varnothing_j(\lambda k \lambda y. E_k(y))))]\]

As is apparent from the above, our semantics for paint converts intensional quantifiers (i.e. the classical denotations of DPs; see Montague, 1970, 1973) into propositionally coded situations during semantic composition. In particular, the function in (47) applies to the quantifier that is denoted by the object DP to assert the obtaining of a painting relation to (the set of situations representing) a situation that is inhabited by the individual referent of this quantifier.

4. Explaining the Properties

With our basic semantics for depiction verbs in place, we are now ready to show that this semantics accounts for Properties (i) to (iii).

4.1. Explaining Property (i): missing de dicto-readings

Our semantics for paint in (47) enables the interpretation of the different readings of depiction reports with indefinite object DPs as desired (see the interpretation of (1a) in (48a/b)):

(48) a. \[\text{[(3a)]}^i \equiv [\text{Penny is painting [a penguin]}]^i \]
   \[= \lambda \varnothing \lambda z(\exists e)[\text{paint}_i(e, z, f_e(\lambda j. \varnothing_j(\lambda k \lambda y. E_k(y))))] (\lambda l \lambda P(\exists x)[\text{penguin}_i(x) \land P_l(x)])(\text{penny}) \]
   \[\equiv (\exists e)[\text{paint}_i(e, \text{penny}, f_e(\lambda j \exists x. \text{penguin}_i(x) \land E_j(x)))] \]
   \[\equiv (\exists e)[\text{paint}_i(e, \text{penny}, f_e(\lambda j \exists x. \text{penguin}_i(x)))] \]

b. \[\text{[(3b)]}^i \equiv [\text{[a penguin] } \lambda_1 [\text{Penny is painting } t_1]]^i \]
   \[= \lambda P(\exists x)[\text{penguin}_i(x) \land P_l(x)](\lambda j \lambda x_1(\exists e)[\text{paint}_j(e, \text{penny}, f_e(\lambda j. E_j(x_1)))] \]
   \[\equiv (\exists x)[\text{penguin}_i(x) \land (\exists e)[\text{paint}_i(e, \text{penny}, f_e(\lambda j. E_j(x)))] \]

To account for the non-availability of the non-specific reading of (4) (i.e. Penny is painting every penguin), we follow Zimmermann’s (1993) assumption that the denotation of paint (here: paint) is only defined for the interpretations of object DPs that can be represented by an existential quantifier (see Section 2, Challenge (i)). This assumption takes the form of a presupposition on the quantifier \(\varnothing\) in (47). This presupposition is specified in (49), where it is underlined:

(49) \[\text{paint-DP}^i_{\text{revised}} = \lambda \varnothing : (\exists P)[\varnothing \equiv \exists P]. \lambda z(\exists e)[\text{paint}_i(e, z, f_e(\lambda j. \varnothing_j(\lambda k \lambda y. E_k(y))))] \]

Since (4a) does not meet this presupposition on the non-specific reading of its object DP, this reading is not available in our semantics. However, since the trace of this DP has an interpretation (i.e. \(\text{LIFT}(\text{[1]})(= \lambda \lambda Q. Q_l(x_1)\)) that can be represented by an existential quantifier (here: by \(\lambda \lambda Q. \exists x. Q_l(x) \land x = x_1\)), the specific reading of (4), i.e. (4b), is still available in our semantics. This reading receives the interpretation in (50):

(50) \[\text{[(4)]}^i_{\text{specific}} \equiv [\text{[every penguin] } \lambda_1 [\text{Penny is painting } t_1]]^i \]
   \[= \lambda P(\forall x)[\text{penguin}_i(x) \rightarrow P_l(x)](\lambda j \lambda x_1(\lambda \varnothing \lambda z(\exists e)[\text{paint}_j(e, z, f_e(\lambda j. \varnothing_j(\lambda k \lambda y. E_k(y))))])(\lambda l \lambda Q. Q_l(x_1))(\text{penny}) \]
   \[\equiv \lambda P(\forall x)[\text{penguin}_i(x) \rightarrow P_l(x)](\lambda j \lambda x_1(\exists e)[\text{paint}_j(e, \text{penny}, f_e(\lambda k. E_k(x_1)))] \]
   \[\equiv (\forall x)[\text{penguin}_i(x) \rightarrow (\exists e)[\text{paint}_i(e, \text{penny}, f_e(\lambda j. E_j(x)))] \]
4.2. Explaining Property (ii): no inferences to a common objective

The above considerations suggest that (7a/b) receive an interpretation along the lines of (52). This interpretation uses a semantics for imagine (see (51)) that is fully analogous to that of paint. For simplicity, we will hereafter drop the ‘existential quantifier’-presupposition from (51).

\[ \text{imagine-DP}^i = \lambda \exists S [\exists x (\exists y E_k(y)) (\lambda z (\exists e) [\text{imagine}_i(e, z, f_e(\lambda j. S_j(\lambda k \lambda y. E_k(y))))]) ] \]

\[ \text{(7a)}^i_{\text{non-specific}} \equiv \text{Uli is imagining [something]}^i = \lambda \exists S \exists z (\exists e) [\text{imagine}_i(e, z, f_e(\lambda j. \exists u. S_j(\lambda k \lambda y. E_k(y) \land u = y))) ] (\lambda l \lambda P(\exists x)(\exists y)(\lambda k \lambda y. E_k(y))) (\lambda u) \]

We have explained in Section 3 that our semantics interprets the direct objects of depiction verbs as propositionally coded situations. Our interpretation suggests that situations have propositionally coded partial content reading (i.e., the conjunction of the propositions that are true in the situation). A (proper) part of this content is made explicit in the domain of the parametrized choice function \( f_e \). For example, in (50), this ‘explicit content’ is the proposition/set of worlds \( \lambda j (\exists x) [\text{penguin}(x)] \).

As a result, it holds for all propositionally coded\(^1\) situations \( f_e(p) \) that \( f_e(p) \subseteq p \).

In virtue of the above, (coded) situations serve a double role in our semantics: as the semantic arguments of depiction verbs and as carriers of the propositional content that is represented in the relevant act of depiction (cf. Kratzer, 2002). In virtue of this double role, (7c) has two different ‘readings’ in our semantics: one of these readings (hereafter called the situation reading, abbreviated ‘SR’) reports the existence of a situation that Uli and Ede are both imagining. The other reading (called the partial content reading, ‘PCR’) reports the existence of a partial propositional content (i.e., \( \lambda j (\exists x) [E_j(x)] \)) that characterizes both Uli and Ede’s imagined situations. Since situations are informationally richer objects that ‘classical’ propositions (see Section 3), the situation reading is the stronger one of the two readings, i.e. SR entails PCR, but not vice versa.

We assume that (7c) saliently has a situation reading.\(^1\) To interpret this reading, we use the semantics for ‘propositional’ occurrences of imagine in (53). Our use of this semantics is motivated by the fact that this semantics assumes the same form for the domain of the existential quantifier ‘there is some-thing’ and as the semantic argument of the depiction verb. We will see in Section 4.4 that (53) also provides the semantics for finite CP-taking occurrences of imagine.

\[ \text{imagine-CP}^i = \lambda p \lambda z (\exists e) [\text{imagine}_i(e, z, p)] \]

To obtain the suitably typed higher-order reading of the occurrence of something in (7c) (see (55)), we use the type-shifter \( \cong \). This shifter sends intensional quantifiers to parametrized sets of objects of type \( \langle s, (s, t), t \rangle \) that apply to an existentially quantified proposition:

\[ \cong := \lambda \exists S \exists T (\exists p) [p = (\lambda k. S_k(\lambda l \lambda y. y = y) \land T_j(p))] \]

\(^1\)Since we already work with propositional representations of situations, we do not need a designated function (e.g. Kratzer/Hacquard’s (2006: 138) function \( \text{CON} \)) that identifies the propositional content of an entity/situation.

\(^1\)This assumption is motivated by the intuitive non-validity of (7) (see Zimmermann, 2006). The partial content reading of (7c) will be discussed in Section 4.3.
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The situation reading of (7c) then has the interpretation in (56):

\[
[[7c]]_{\text{SR}}^i \equiv [[\text{some (coded) situation}]]^i
\]

The above asserts the existence of a maximally general situation\(^{15}\) that Uli and Ede are both (simultaneously) imagining. However, since depiction verbs choose their argument-situation in dependence on a particular depicting event (here: Uli’s resp. Ede’s imagining in \(i\); see Section 3) and since different cognitive agents rarely share the same imagining event (even if their imagining happens at the same time and has the same (kind of) content), Uli’s imagined situation in \(i\) is typically different from Ede’s imagined situation in \(i\) – to the extent that it may even be part of a different world. The inference from (7a) and (7b) to (7c) is thus not valid in our semantics: \(^{16}\)

\[
[[7a]]_{\text{non-specific}} = [[\text{Uli is imagining } \exists p \text{ (non-specific) thing}]]^i
\]

\[
[[7b]]_{\text{non-specific}} = [[\text{Ede is imagining } \exists p \text{ (non-specific) thing}]]^i
\]

\[
[[7c]]_{\text{SR}} = [[\text{There is } \exists p \text{ a situation} \text{ that Uli and Ede are (both) imagining}]]^i
\]

4.3. Excursus: criteria for ‘same-imagining’

We have mentioned above that our semantics admits two different readings of (7c): a situation reading (SR; see (56)) and a partial content reading (PCR). We show below that PCR solves a problem concerning the generalizability of our approach to inferences to a common objective. This problem regards the observation that, on the conclusion’s situation reading, our semantics also blocks inferences like (58) that would intuitively be regarded as valid. In blocking (58), our semantics follows Zimmermann’s (2006) property-based semantics (see ibid.: 741).

\[
\alpha \rightarrow (\text{Lea is imagining } \exists p \text{ (non-specific) lion})
\]

\[
\beta \rightarrow (\text{Paul is imagining } \exists p \text{ (non-specific) lion})
\]

\[
\alpha \Rightarrow \beta \rightarrow (\text{There is } \exists p \text{ (kind of) thing} \text{ that Lea and Paul are both imagining})
\]

\(^{15}\)The equivalence of the final and the penultimate line in (56) is due to the non-emptiness of imagined situations. The latter is the assumption that every situation is inhabited by at least one individual.

\(^{16}\)Note that, in each depiction event \(e\), the depicting agent stands in the depiction relation to exactly one (propositionally coded) situation. As a result, (57c) cannot be taken to assert (truly) that Uli’s and Ede’s imagining situations share the same generalization.
Zimmermann defends the predictions of his semantics by referring to the strict requirements on two agents sharing the (exact) same target of depiction (see Zimmermann, 2006: 745–747). According to (an adapted version\(^\text{17}\) of his argument, if Lea is imagining an Asiatic lion and Paul is imagining a (now extinct) Cape lion, the premises in (58) are both true on their non-specific readings, while the conclusion is false (see Zimmermann, 2006: 742).

Zimmermann’s argument notwithstanding, it seems that – in a way – Lea and Paul could still be described as imagining the same thing, viz. a lion. Our semantics captures the validity of this inference by using PCR: to obtain the higher-order reading of the DP something as a quantifier over partial propositional contents of situations (cf. (23)), we use a modified version, \(\uparrow\), of Zimmermann’s type-shifter \(\uparrow\). Like \(\uparrow\), this version replaces the quantifier over properties, \(\exists p\)’, in (24) by a quantifier over propositions, \(\exists p\)’. To ensure the desired interpretation of \(\text{some}_{\text{HO}}(\uparrow \text{thing}_{\text{LO}})\), we replace the conjunct ‘\(P_k(y)\)’ in (24) by ‘\(p_k\)’:

\[
\uparrow := \lambda Q \lambda j \lambda \mathcal{D} (\exists p)[\mathcal{D} = (\lambda k \lambda P \exists y. Q_k(y) \land p_k \land P_k(y))] \\
]\[
\text{some}_{\text{HO}}(\uparrow (\text{thing}_{\text{LO}})) = \lambda \Sigma \lambda j \lambda \Pi (\exists \mathcal{D})[\Sigma j(\mathcal{D}) \land \Pi j(\mathcal{D})] \\
= (\lambda Q \lambda \lambda \mathcal{P} (\exists p)[\mathcal{P} = (\lambda k \lambda P \exists y. Q_k(y) \land p_k \land P_k(y))])(\lambda l \lambda z. z = z) \\
= \lambda j \lambda \Pi (\exists \mathcal{D})(\exists p)[\mathcal{D} = (\lambda k \lambda P \exists y. p_k \land P_k(y))] \land \Pi j(\mathcal{D}) \\
= \lambda j \lambda \Pi (\exists p)[\Pi j(\lambda k \lambda P \exists y. p_k \land P_k(y))] \\
\]

The above enables the compositional interpretation of the partial content reading of (7c):

\[
[[\text{some propositional content}]]^i \equiv [[[\text{some propositional content}] \lambda_1 [\text{Lea is imagining } \mathcal{P}_1 \text{ and Paul is imagining } \mathcal{P}_1]]]^i \\
= \lambda \Pi (\exists p)[\Pi_1(\lambda j \lambda P \exists y. p_j \land P_j(y))](\lambda k \lambda \mathcal{D} (\exists e) [\text{imagine}_k(e, \text{lea}, f_e(\lambda j \exists x. \mathcal{D}_j(\lambda \lambda y. x = y))) \land (\exists e') [\text{imagine}_k(e', \text{paul}, f_{e'}(\lambda j \exists z. \mathcal{D}_j(\lambda \lambda u. z = u)))])] \\
= (\exists p)[(\exists e) [\text{imagine}_k(e, \text{lea}, f_e(p))] \land (\exists e') [\text{imagine}_k(e', \text{paul}, f_{e'}(p))]] \\
\]

(61) asserts the existence of a proposition that is part of the propositional content both of Lea’s and of Paul’s imagined situation. Since this proposition indeed exists (witness \(\lambda j (\exists x)[\text{lion}_j(x)]\)), the inference in (58) comes out valid, as desired:

\[
\begin{align*}
\text{a. } &[[\text{58a}]]^i_{\text{non-specific}} \equiv [[\text{Lea is imagining } \exists_p \text{some (non-specific) lion}]]^i \\
&= (\exists e) [\text{imagine}_k(e, \text{lea}, f_e(\lambda j \exists x. \text{lion}_j(x)))] \\
\text{b. } &[[\text{58b}]]^i_{\text{non-specific}} \equiv [[\text{Paul is imagining } \exists_p \text{some (non-specific) lion}]]^i \\
&= (\exists e') [\text{imagine}_k(e', \text{paul}, f_{e'}(\lambda j \exists x. \text{lion}_j(x)))] \\
\Rightarrow \text{c. } &[[\text{58c}]]^i_{\text{SR}} \equiv [[\text{There is } \exists_p \text{a proposition} \text{ whose content Lea and Paul are imagining}]]^i \\
&= (\exists p)[(\exists e) [\text{imagine}_k(e, \text{lea}, f_e(p))] \land (\exists e') [\text{imagine}_k(e', \text{paul}, f_{e'}(p))]] \\
\]

Arguably, on the partial content-reading of its conclusion, (7) also comes out valid. We explain this validity by pointing to the observation that, given the PC-reading of (7c), the inference is indeed more likely to be judged valid by native speakers. The intuitive invalidity of (7) can still be explained with reference to the salience of the situation reading (see Section 4.2).

\(^{17}\)The adaptation is to our example.
4.4. Explaining Property (iii): DP/CP interaction

We have suggested in Section 4.1 that our semantics assumes different lexical entries for DP- (see (51)) and CP-taking occurrences of depiction verbs (see (53), copied below). These different entries are required by our assumption that DPs and finite CPs have their usual denotation in our semantics (i.e. intensional quantifiers resp. propositions). Since our semantics uniformly interprets depiction complements as propositions/propositionally coded situations (type \(\langle s, t \rangle\)), it requires different verb-internal type-shifters, viz. functions from intensional quantifiers to propositions (i.e. \(\lambda. \mathcal{D} \lambda j (\exists x)[\mathcal{D} j (\lambda k \lambda y. E_k(y) \land y = x)]\); see (51)) and functions from propositions to themselves/to propositions (i.e. \(\lambda p \lambda j [p_j]\); see (53)).

\[
\text{imagine-DP}] = \lambda. \mathcal{D} \lambda z (\exists e)[\text{imagine}_i(e, z, f_e(\lambda j \exists x. \mathcal{D} j (\lambda k \lambda y. E_k(y) \land y = x)))]
\]

\[
\text{imagine-CP}] = \lambda p \lambda z (\exists e)[\text{imagine}_i(e, z, p)]
\]

Our semantics for CP-taking occurrences of imagine enables the interpretation of (8b) as (64). This interpretation treats that as the trivial complementizer, \(\text{that}_T\) (see (63); cf. Kratzer, 2006):

\[
\text{that}_T = \lambda p \lambda j [p_j]
\]

\[
[(8b)] = [(\exists e)[\text{imagine}_i(e, uli, \lambda j \exists x. \text{unicorn}_j(x) \land \text{bask}_j(x))] = (\exists e)[\text{imagine}_i(e, uli, \lambda j \exists x. \text{unicorn}_j(x) \land \text{bask}_j(x)]
\]

The uniform(-type) interpretation of DP and CP complements of depiction verbs correctly predicts that these complements allow for coordination and specification (see (9)). This prediction notwithstanding, the modelling of DP/CP coordinations in depiction complements is challenged by the fact that the DP and the CP conjunct provide different-type inputs to the compositional machinery. As a result, the DP conjunct requires embedding by IMAGINE-DP (see (52); cf. (50)) while the CP conjunct requires embedding by IMAGINE-CP (see (53); cf. (64)).

To accommodate these different type-requirements, we use the semantics for coordinating and in (65). This semantics interprets the conjunction of a DP and a finite CP as an intensional quantifier of the form \(\lambda j \lambda P [\mathcal{D} j (P) \land \mathcal{C} j (P)]\).

\[
\text{DP-and-CP-FIN} = \lambda p \lambda \mathcal{D} \lambda j \lambda P [\mathcal{D} j (P) \land p_j]
\]

The above enables the interpretation of (9a) as (67). This interpretation uses the step in (66):

\[
[(\exists x. \text{unicorn}_j(x) \land \text{bask}_j(x))] = (\lambda j \lambda P [\mathcal{D} j (P) \land p_j])
\]

\[
\text{Alternatively, we could try to interpret this conjunction by shifting the quantifier-denotation of the DP to the type for propositions, \(\langle s, t \rangle\). This could be achieved by the function } \lambda. \mathcal{D} j [\mathcal{D} j (\lambda k \lambda y. E_k(y))] \text{. The value of this function would qualify as input to the familiar, generalized interpretation of conjunction (i.e. } \lambda q \lambda j [p_j \land q_j]) \text{. However, since this function is not an admissible type-shift (for example, it is not injective; see Zimmermann, 2015) and since it could also be used to resolve a (well-motivated) type-mismatch between propositional attitude verbs (e.g. think) and non-content DPs (e.g. a penguin; thus blocking a type-theoretic explanation of the deviance of *Uli is thinking a penguin), we refrain from using this option.}
(67) \[ \{ (9a) \}^i \equiv \square [ \text{Uli imagines-DP} \left[ \text{[a unicorn] } [ \lambda_1 (J (T, \lambda \text{ and that } T \text{ is basking in the sun})] \right] \]
\[ \equiv \lambda_2 \lambda z (\exists e)[ \text{\textit{imagine}}(e, z, \lambda f (\lambda j \exists x. \textit{bask}_j (\lambda k \lambda y. E_k (y) \wedge y = x)))]
\[ \equiv (\exists e)[ \text{\textit{imagine}}(e, \textit{uli}, \lambda f (\lambda j \exists x. \textit{unicorn}_j (x) \wedge E_j (x)) \wedge (\exists y. \textit{unicorn}_j (y) \wedge \textit{bask}_j (y)))]
\]

We close this section with an observation about the relation between \textit{imagine-CP} and \textit{imagine-DP}: the attentive reader may have noticed that our translations of both kinds of occurrences use the same non-logical constant, \textit{imagine}. Together with (51) and (53), this observation supports the meaning postulate in (68):

\[ \forall (\exists) (\forall z) [ \text{\textit{imagine-DP}}((\exists e)(z) \equiv \text{\textit{imagine-CP}}((\lambda j \textit{bask}_j (E) \wedge (\forall q. (f_e (p) \subseteq q) \rightarrow q_j))(z)]
\]

In its relevant instance, (68) asserts the semantic equivalence of (2a) with the result of replacing its object DP with a complex finite clause (or a coordination of finite clauses) that denotes the complete propositional content which serves as the interpretation of this DP. For example, if the propositional content of Uli’s imagined situation in \( i \) is fully characterized by the proposition \textit{A white unicorn with a spiralled horn is basking in the sun}, (2a) is equivalent to (69b) and (69c):

\[ \textbf{(69)} \]
\begin{itemize}
  \item a. Uli is imagining \([\text{DP:a unicorn}]
  \equiv b. Uli is imagining \([\text{CP:that a white unicorn with a spiralled horn is basking in the sun}]
  \equiv c. Uli is imagining \([\text{(that there is) [a white unicorn]}^1, \text{[CP:that it}_1 \text{ has a spiralled horn], and [CP:that it}_1 \text{ is basking in the sun}]]
\end{itemize}

The semantic equivalence of transitive with certain clausal occurrences of depiction verbs has important consequences for the recent debate about the defensibility of propositionalism in linguistic semantics. Propositionalism is the claim that all intensional constructions (incl. depiction reports) can be interpreted as cases of truth-evaluable, clausal embedding.\(^{19}\) There are today several different forms of propositionalism. These differ with respect to whether the propositional interpretation of the object DP is achieved by lexical decomposition (\textit{weak propositionalism}; see Quine, 1956), by syntactic restructuring (\textit{sententialism}; see Larson, 2002; den Dikken et al., 2018), by ellipsis resolution (see Parsons, 1997), or by a type-shift to a proposition (\textit{Propositionalism} (with a capital ‘P’); see Zimmermann, 2016).

Since they deny that depiction reports can be decomposed, restructured, or resolved into a clausal structure – and since there is no injective function from properties or intensional quantifiers to propositions –, most existing semantics for depiction reports (see Zimmermann, 1993, 2006, 2016; Moltmann, 1997) are in line with some form or other of anti-propositionalism. Things are different for our proposed semantics for depiction reports: admittedly, this semantics still refutes the decomposition, restructuring, or resolution of depiction reports into a clause-embedding construction.\(^{20}\) However – as we have shown in Section 3 –, our semantics interprets the object DPs of depiction verbs as (propositionally coded) situations. Since these stand in a one-to-one correspondence to propositions, our semantics still supports Propositionalism.

\(^{19}\)The term \textit{propositionalism} is due to Forbes (2000: 148) who, however, defends an anti-propositionalist view.

\(^{20}\)For an argument against Parsons’ ellipsis analysis of depiction reports, the reader is referred to (Liefke, 2020).
5. Conclusion

In this paper, we have observed that the compositional interpretation of depiction reports faces several challenges regarding available readings, entailment patterns, and DP/CP interaction. We have shown that our proposed semantics answers these challenges by interpreting the object DP in ‘nominal’ depiction reports as a propositionally coded situation that depends on the relevant depicting event, and by interpreting the finite CP in clausal depiction reports as a classical proposition: the former effects that non-specific DPs in inferences to a common objective do (typically) not receive the same interpretation, such that these inferences come out invalid. Because of the same-type interpretation of nominal and clausal depiction complements, the latter enables the semantic interaction of DPs and CPs in the complements of depiction verbs.

We close this paper with two pointers to future research. The first of these concerns the extension of our defense of a Propositionalist account of intensional constructions to other verbs: our adoption of Stephenson’s evidence for the presence of a semantic situation argument suggests that all intensional verbs that select for a semantic situation argument allow for a Propositionalist treatment. These verbs include – next to other depiction verbs (e.g. draw, visualize) – epistemic verbs (e.g. remember, notice, observe), quasi-perceptual intentional verbs (e.g. dream (about/of), hallucinate), and perception verbs (e.g. see, hear, feel).

Our second pointer regards the same-type interpretation of DP and CP complements of depiction verbs. This interpretation opens up new possibilities for the explanation of the distribution of DPs and CPs: since this interpretation predicts that depiction verbs combine with both DPs and CPs, it suggests that their selectional restrictions (e.g. the fact that – in contrast to imagine – paint rejects finite CP complements) can be accounted for in terms of independently observable semantic properties of these verbs.\textsuperscript{21} For an initial attempt at such an account, the reader is referred to (Liefke, 2019). We leave the development of this account to future work.

References


\textsuperscript{21}I thank Floris Roelofsen for directing my attention to this point.


Utterances with themes as strategies to address a broad Question Under Discussion1
Laia MAYOL — Universitat Pompeu Fabra
Enric VALLDUVÍ — Universitat Pompeu Fabra

Abstract. In a QUD-model of discourse, any utterance elaborates on the maximal QUD in that context. QUDs play an essential role in defining the two parts in which an utterance can be divided: theme and rheme. An utterance must always contain a rheme, which is the part that elaborates on the QUD, and may contain a theme, which replicates content already present in the QUD. Since themes are replicating material already present in the QUD, one may wonder why themes are uttered at all. Vallduví (2016) proposes that themes signal the QUD update will have an intermediate step and that the QUD being addressed is not the maximal one. In other words, themes mark that the QUD update is non-default. The goal of this paper is to empirically examine one of these non-default updates and, in particular, whether theme-containing utterances can be used to signal that the QUD being addressed is broader than the maximal one and, if so, whether they are necessary in this situation. Two discourse-completion studies in Catalan were carried out. The results show that theme-containing utterances are mostly used to address a broad QUD (as opposed to narrower ones) and that when speakers decide to address a broad QUD, the proportion of theme-containing utterances increases significantly. The use of themes is, however, not required to signal this change of QUD; themeless-utterances can also be used in this context.

Keywords: Question Under Discussion, QUD, theme, rheme, context

1. Introduction
Krifka and Musan (2012) define information structure as concerning ‘those aspects of natural language that help speakers to take into consideration the addressee’s current information state, and hence to facilitate the current flow of information’ (2012: p.1), where the addressee’s current information state is taken to function as context of utterance in the relevant sense. Thus, from this perspective, the information structure of a particular utterance $U$ is taken to reflect the manner in which $U$ effects the update of the input context $C_1$, the context in which it is uttered.

Central to information structure are the well known utterance-level notions of theme and rheme, where themes are taken to perform a backward-looking role, somehow anchoring the utterance to $C_1$, while the rheme is seen as performing a forward-looking role, acting as exponent of the progression from the input context $C_1$ to the output context $C_2$, which is obtained after $U$ is computed. In other words, the rheme encodes the update potential of $U$.

The point of any given utterance is to make the conversation progress, i.e., to provide an update for $C_1$. In view if this, Vallduví (1992), among others, argues that the rheme is, in fact, the only obligatory element in the theme-rheme partition, whereas themes appear when the backward-looking task they carry out is required in particular conversational situations. In other words, the presence of a theme in any given utterance, i.e. theme-containing utterances, would be flagging

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some kind of *nondefault* contextual update, whereas themeless utterances would somehow have a default status.

This is indeed the case in conversational query-answer pairs. The query in a query-answer pair evokes a context \( C_1 \) and the answer spells out the update to \( C_1 \). Take for instance the following example:

(1) a. What are we having for dinner?  
   b. FISH.

The answer to the query here is a fragment utterance. Fragment utterances, i.e. themeless utterances like *fish*, are in fact the default type of direct answer in a query-answer pair like this one. A theme-containing utterance like ‘We are having fish’ would be marked in a query-answer pair like (1) but, in contrast, becomes necessary in an exchange like (2), since, as mentioned, theme-containing utterances flag that the contextual update is somehow non-default.

(2) a. What are we having for dinner?  
   b. FISH.  
   c. Oh, not again! We have fish several days a week...! Can’t we order pizza?  
   d. We are having FISH.

Theme-containing (2d) is an answer to query (2a). The theme allows (2d) to be a non-local answer to (2a). In other words, (2d) elaborates on a Question Under Discussion that is not the most salient Question Under Discussion at the time of utterance: the role of the theme is to re-raise the Question Under Discussion to maximality.

Non-local elaborations such as the one in (2) are just one type of non-default update that is flagged by theme-containing utterances. The goal of this paper is to examine the availability of another such non-default contextual update: an update in which the maximally prominent Question Under Discussion is replaced by a related, broader one. The paper is structured as follows: Section 2 presents the background assumed in this paper, sections 3 and 4 present two discourse-completion experiments in Catalan and section 5 concludes the paper with some discussion.

2. Background

In a Question Under Discussion (QUD)-model of discourse (Ginzburg, 1994; Roberts, 1996) any utterance \( U \) uttered in a context \( C_1 \) elaborates on the maximal QUD in that context (max-QUD\(_{C_1}\)). Following Vallduví (2016), QUDs play an essential role in defining the two parts in which an utterance can be divided: theme and rheme. An utterance must always contain a rheme, which is the part that elaborates on the QUD, its actual update potential. It may also optionally contain a theme, which replicates content already present in the QUD. For instance, the explicit QUD in (1a) is answered in (1b) by an all-rhematic fragment utterance. This query could also be answered by an utterance containing a theme, as ‘We are having’ in (2d), which does not address the QUD but merely replicates material from the QUD.

In addition to elaborating on the maximal QUD, an utterance also introduces a new QUD, which is the one that is maximally prominent in the output context. For instance, utterances (1b) or (2d) introduce the QUD ‘Are we having fish for dinner?’, which another participant in the conversation can elaborate on, as shown by the utterance in (3c).
A: What are we having for dinner?
B: Fish // We are having fish for dinner.
C: No, that’s not true!

Since themes in theme-containing utterances are replicating material already present in the QUD, it is only natural to wonder why themes are uttered at all. Vallduví (2016) proposes that themes signal the QUD update will have an intermediate step; the QUD the utterance addresses is not the maximal QUD, but a related one. That is, theme-containing utterances promote one particular QUD so that it replaces the one that was maximally prominent in the context. One case in which this occurs is when the maximal QUD is split into several subQUDs, as extensively studied by Büring (2003), among others, and illustrated in (4). Speaker B decides not to address directly the maximal QUD (the explicit query posed by A), but instead divides the QUD into more specific QUDs: namely ‘How was the sound?’, ‘How was the audience?’ and ‘How was the band?’. In order to identify which QUD is being addressed, the presence of themes (‘the sound’, ‘the audience’ and ‘the band’ respectively) becomes essential.

A: How was the concert?
B: The sound was awful, but the audience was enthusiastic, and the band was fantastic.

Now, it should follow that the opposite direction is also possible. Themes should also be able to indicate that the utterance is elaborating on a QUD that is broader than the maximal QUD. That is, if a particular issue \( i_1 \) is being discussed, then broader issues \( i_2 \) and \( i_3 \) which include \( i_1 \) are also discussed. This is illustrated in (5) (based on a similar example by Steedman (2014)):

A: Will Anna marry Manny?
B: Anna HATES Manny.

The maximal QUD introduced by speaker A is whether Anna will marry Manny. The theme-containing utterance produced by speaker B does not directly answer the maximal QUD, but instead introduces a new QUD, namely how Anna feels about Manny. Clearly both QUDs are related and the issue of the relationship between Eva and Manny is broader than the issue of Eva marrying Manny. If we are discussing whether Anna will marry Manny, we are also discussing how she feels about him, and by elaborating on the broader QUD we can also reasonably infer the answer to the explicit query.

While the existence of query-answer pairs such as the one illustrated in (5) is predicted to be possible and discussed by Vallduví (2016) and Steedman (2014), there are no empirical studies we are aware of that have demonstrated that it is indeed possible to answer a query by elaborating on a broader QUD. This paper aims to fill this gap by answering the following two questions: Can themes also signal that the QUD being addressed is a broader QUD than the maximal one? If they can, are they necessary to do so?

We aim to answer these questions by means of two discourse-completion studies in Catalan, where the mapping between syntax and information structural categories is fairly transparent. In particular, themes are encoded at the beginning or end of the clause (Vallduví, 1992). We will consider three main cases in which themes are expressed: (i) when the utterance contains a preverbal overt subject, as in (6a), as opposed to a null subject, as in (6b), (ii) when the ut-
terance contains a preverbal dative occurring with a psychological verb, as in (7a), as opposed to utterances without an overt dative argument, as in (7b), and (iii) when the utterance contains a right-dislocated phrase, as in (8a), or a left-dislocated phrase, as in (8b), as opposed to utterances without dislocation, as in (8c) (see Vallduví (1992) and Villalba and Mayol (2013) for more discussion of the information structure of dislocations in Catalan).

(6) a. *El Pep* no beu *vi.*
   the Pep not drink-3SG wine
   ‘Pep does not drink wine.’

      b. No beu *vi.*
         not drink-3SG wine
         ‘He does not drink wine.’

(7) a. *Al Pep* no li agrada el *vi.*
   to the Pep not DAT like-3SG the wine
   ‘Pep does not like wine.’

      b. No li agrada el *vi.*
         not DAT like-3SG the wine
         ‘He does not like wine.’

(8) a. No en beu, *de vi.*
   not PART; drinks, of wine$_i$

      b. *De vi,* no en beu.
         Of wine$_i$ not PART; drinks
         ‘He does not drink wine.’

      c. No en beu.
         not PART; drinks.
         ‘He does not drink it.’

3. Experiment 1

Experiment 1 is a discourse-completion study, in which we manipulated the amount of information available to participants to answer a query. This allowed us to study if there is a correlation between using a theme and addressing a broader QUD.

3.1. Methods

*Materials*

Participants were asked to answer a query by completing its answer. All answers that participants had to complete started either with ‘Yes’ or ‘No’. In advance, they were given some contextual information and were told that they should answer the queries on the basis of this information.

The experiment has one factor with two conditions. The contextual information participants received to answer the query could be of two types: (i) in the Small Context Condition, participants received only the information necessary to answer the query, while in the Large Context Condition, participants received more information than what was necessary to answer the query.

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2The following abbreviations are used in the glosses: **COND** (conditional), **PART** (partitive clitic), **SG** (singular), **SUBJ** (subjunctive).
query. In other words, the sentence in the Large Context Condition asymmetrically entails the sentence in the Small Context Condition. (9) illustrates the two conditions and (10) the query and the answer to be completed.

(9)  
\[ \text{a. Al Pere no li agrada gens el lluç.} \]
\[ \text{To the Pere not DAT like-3SG at all the hake} \]
\[ \text{Pere does not like hake at all.} \]
\[ \text{[Small Context Condition]} \]
\[ \text{b. Al Pere no li agrada gens el peix.} \]
\[ \text{To the Pere not DAT like-3SG at all the fish} \]
\[ \text{Pere does not like fish at all.} \]
\[ \text{[Large Context Condition]} \]

(10)  
\[ \text{a. Li faig lluç per sopar, al Pere?} \]
\[ \text{DAT make-1SG hake for dinner, to the Pere} \]
\[ \text{Should I cook Pere some hake for dinner?} \]
\[ \text{[Query]} \]
\[ \text{b. Sí, ...} \]
\[ \text{Yes, ...} \]
\[ \text{[Answer]} \]

As can be seen, the information in both conditions is sufficient to answer the query. However, in both cases, it takes an inference to do so: if Peter does not like hake, it can reasonably be concluded that I should not cook some hake for Pere, but this is not a logical necessity (i.e. it may be that I should cook Pere some hake, even if he does not like it, because the doctor said that he should eat fish once a day). We choose to pose a query that could be answered by abductive reasoning, as opposed to deductive reasoning (i.e. ‘Does Pere like fish?’), to make the task more natural and interesting. Otherwise, the task may have been too monotonous, which could have affected the productions of our participants.

It should also be noted that all the answers start with a response particle; half of the answers start with ‘Yes’ and the other half with ‘No’. These response particles are rhematic, since they directly address the explicit polar question posed. Response particles are, however, fully compatible with propositional answers, which may vary in their complexity and information structure, i.e. they may contain only rhematic information, just like the answer particle (see (11a)) or incorporate thematic material (see (11b)).

(11)  
\[ \text{a. Sí, fes -li.} \]
\[ \text{Yes, make-2SG DAT} \]
\[ \text{‘Yes, you should.’} \]
\[ \text{b. Sí, al Pere li agrada el lluç.} \]
\[ \text{Yes, to the Pere DAT like-3SG the hake.} \]
\[ \text{‘Yes, Peter likes hake.’} \]

The experiment included 16 critical items, all with the structure illustrated above. Two lists were built, so that each participant only saw each item in one of the conditions. Each list also contained 16 fillers, in which the context contained information from which the answer to the query could be inferred. In those cases, the answer did not start with ‘Yes/No’, but was completely free. The 32 items were presented in randomized order to the participants.

**Procedure**

The data was collected on an online survey site (https://spellout.net/ibexfarm). First, the participants read the consent form and the instructions in which the procedure was explained.
The instructions stated that they would read a sentence and then would be asked to answer a query on the basis of what they had read. They were asked to answer with a full sentence. An example was presented, with several possible answers, some with a theme and some without. Then, each item was presented one at a time. Finally, some data about the linguistic profile of the participants was recorded.

Participants

Thirty-five participants took part in the experiment. They were all native speakers of Catalan and students at the Universitat Pompeu Fabra. As compensation for their participation, they were entered in a raffle to win a gift certificate.

3.2. Data coding

A total of 560 answers (16 items * 35 participants) were collected. One of the authors of the paper coded the answers as either themeless or theme-containing. As explained in section 2, an answer was coded as having a theme if it contained a preverbal overt subject, (12a), a preverbal dative with a psychological verb, (12b), or phrases dislocated to the left or to the right, (12c). If the answer had none of these elements, it was coded as themeless, as the examples in (13).

(12) a. Ell odia el peix.
   he hate-3SG the fish
   ‘He hates fish.’
   b. Al Pere no li agrada gens el peix.
      to the Pere not DAT likes all the fish
      ‘Pere does not like fish.’
   c. No li facis iluç, al Pere.
      not DAT make-SUBJ-2SG hake, to the Pere.
      ‘Do not cook hake for Peter.’

(13) a. No li agrada.
   not DAT like-3SG
   ‘He doesn’t like it.’
   b. Detesta el pescado.
      hate-3SG the fish
      ‘He hates fish.’

In addition, in the case of data from the Large Context Condition, it was also coded whether the answer addressed the broad QUD (‘Does Peter like fish?’) or a narrower QUD. We count answers to both the explicit query (‘Should I cook Peter some hake for dinner?’) and to the query ‘Does Peter like hake?’ as addressing a QUD narrower than the broad QUD. While examples (12a), (12b) and (13b) would be coded as addressing the broad QUD, examples (12c), and (13a) would be coded as addressing a narrow QUD. One answer has incoherent and, thus, was excluded from the analysis.

3.3. Hypotheses

Based on the previous literature (Vallduví, 2016; Steedman, 2014), we formulate the following hypotheses:
1. More themes are expected in the Large Context Condition than in the Small Context Condition, given that in the latter speakers do not have information to address the broad QUD. In contrast, in the former, they can choose between addressing the broad QUD or some narrower QUDs. We expect that the possibility of addressing the broad QUD will correlate with an increase of the proportion of themes.

2. Within the Large Context Condition, more themes are expected if speakers address the broad QUD than if they address a narrower QUD.

3. Within the Large Context Condition, more answers will address the broad QUD if speakers use a theme than if they do not.

3.4. Results

The results are shown in Figures 1, 2 and 3, each addressing the corresponding hypothesis above. To test for the statistical significance of the results, mixed-effect logistic regressions were performed, using R (R Core Team, 2013) and lme4 (Bates et al., 2015). All models contained items and participants as random effects. Likelihood ratio tests are used to compare mixed-effects models differing only in the presence or absence of the fixed effect in question.

Figure 1 shows the proportion of themeless and theme-containing utterances in both conditions. As can be seen, there is no difference between the two conditions and around 30% of the utterances present a theme regardless of their conditions. To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models different only in the presence or absence of a fixed main effect of condition. In both models, theme presence/absence was the dependent variable. The likelihood-ratio test showed no difference between the models ($\chi^2 = 1.06$, $p = .30$).

![Figure 1: Proportion of themes in the two conditions](image)

Thus hypothesis 1 is not borne out. However, so far, we have not examined which QUD speakers are really addressing in the Large Context. In order to do so, let us concentrate on the results obtained in the Large Context Condition. Figure 2 shows the proportion of themeless and theme-containing utterances according to which QUD the speaker is addressing within the Large Context. As can be seen, there is a difference between those cases in which the answer addresses the broad QUD and those in which it addresses a narrower QUD: the proportion of themes is larger when the QUD being addressed is the broadest one. To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models differing only in the presence or absence of a fixed main effect of QUD. In both models, theme presence/absence
was the dependent variable. The likelihood-ratio test showed a main effect of QUD ($\chi^2 = 14.53$, $p < .001$). Thus hypothesis 2 is borne out: the presence of themes is significantly higher when speakers address the broad QUD as opposed to a narrower QUD.

Let us now observe the data from the opposite perspective. Figure 3 shows the proportion of broad and narrower QUDs addressed according to the complexity of the utterance (with or without theme). As can be seen, the proportion of broad QUDs increases when the utterance contains a theme. To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models differing only in the presence or absence of a fixed main effect of presence of theme. In both models, type of QUD (broad vs. narrow) was the dependent variable. The likelihood-ratio test showed a main effect of presence of theme ($\chi^2 = 8.14$, $p < .001$). Thus hypothesis 3 is borne out: answers addressing the broad QUD are significantly higher when they contain a theme.

To sum up the findings in this experiment, (i) when broad QUDs are addressed, the presence of themes increases and (ii) when themes are used, more broad QUDs are addressed. We can also observe that in this latter case (when a theme is used), the majority of QUDs are broad. In contrast, when broad QUDs are addressed, even if the proportion of answer with themes increase, most answers are themeless. That is, themes do not seem necessary to indicate a shift to a broad QUD. We postpone a more in-depth discussion of this result to section 5.
4. Experiment 2

Experiment 2 is another discourse-completion study, which intends to corroborate the findings in Experiment 1 through a different manipulation.

4.1. Methods

Materials

The set-up of the experiment was similar to Experiment 1: participants had to answer a query by completing a sentence on the basis of some contextual information they had previously received. Experiment 2 is different from Experiment 1 in two respects. First, the information participants received was always broader than what was necessary to answer the query (that is, the context was always ‘Large’). Second, there were two types of answer to be completed: while all answers started with either ‘Yes’ or ‘No’, some of the answers also contained a theme. That is, the experiment has one factor with two conditions: Simple Answer, without a theme, or Complex Answer, with a theme. Example (14) shows the context and the query to answer and (15) shows the two types of answer to complete.

(14) a. La Noemí col·lecciona joies antigues.
   the Noemí collect-3sg jewelery antique
   ‘Noemí collects antique jewelery.’
   [Context]

   b. Aquest collaret antic seria un bon regal, per la Noemí?
   This necklace antique be-cond-3sg a good gift, for the Noemí
   ‘Would this antique necklace be a good gift for Noemí?’
   [Query]

(15) a. Sí, ...
   ‘Yes, ...’
   [Simple Answer]

   b. Sí, la Noemí ...
   ‘Yes, Noemí ...’
   [Complex Answer]

The contexts and the queries were the same as used in Experiment 1. Experiment 2 included 16 critical items, along with 16 fillers. Two lists were built, so that each participant only saw each item in one of the conditions. The 32 items were presented in randomized order to the participants.

Procedure and participants

The procedure was the same as explained for Experiment 1. Thirty-three participants took part in the experiment. They were all native speakers of Catalan and students at the Universitat Pompeu Fabra and none of them had participated in Experiment 1. They were entered in a raffle to win a gift certificate.

4.2. Data coding

A total of 528 answers (16 items * 33 participants) were collected. One of the authors of the paper coded whether the answer addressed the broad QUD (‘Does Noemí collect antique jewelery?’) or a narrower QUD. We count answers to both the explicit query (‘Would this antique necklace be a good gift for Noemí?’) and to the query ‘Does Noemí collect antique necklaces?’ as addressing a QUD narrower than the broad QUD. In addition, in the case of
data from the Simple Answer Condition, the answer were coded as either themeless or theme-containing, following the same criteria explained for Experiment 1.

Three answers were excluded from the analysis because they were either incoherent or did not address any of the relevant QUDs.

(16) show some of the answer we obtained together with the coding they received.

(16) a. Ella col·lecciona joies antigues.
She collect-3SG antique jewellery
‘She collects antique jewellery.’ [Broad QUD + theme-containing]
b. A la Noemí, li agradaria.
to the Noemí DAT like-3SG
‘Noemí would like it.’ [Narrow QUD + theme-containing]
c. Col·lecciona joies antigues.
collect-3SG antique jewellery
‘She collects antique jewellery.’ [Broad QUD + themeless]
d. Seria un bon regal
be-COND-3SG a good gift
‘It would be a good gift.’ [Narrow QUD + themeless]

4.3. Hypotheses

In a parallel fashion to what we did for Experiment 1, we formulate the following hypotheses:

4. We expect that the proportion of answers addressing the Broad QUD will be larger in the Complex Answer Condition than in the Simple Answer Condition. Since complex answers always contain a theme, we expect that this will correlate with more answers addressing the Broad QUD.

5. Within the Simple Answer Condition, more answers will address the broad QUD if speakers uses a theme than if they do not.

6. Within the Simple Answer Condition, more themes are expected if speakers address the broad QUD than if they address a narrower QUD.

4.4. Results

The results are shown in Figures 4, 5 and 6, each addressing the corresponding hypothesis above. The same method described for Experiment 1 was used to test for the statistical significance of the results.

Figure 4 shows the proportion of broad and narrow QUDs in both conditions. In the Complex Answer Condition, the proportion of answers addressing the broad QUD is slightly higher (70%) than in the Simple Answer Condition (61%). To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models differing only in the presence or absence of a fixed main effect of condition. In both models, the QUD addressed (broad vs. narrow) was the dependent variable. The likelihood-ratio test showed a main effect of the condition ($\chi^2 = 7.06, p < .01$). Thus hypothesis 4 is borne out.

Let us now concentrate in the results of the Simple Answer Condition so that we can examine
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the types of answers speakers produced and whether they contained a theme or not. Figure 5 shows the proportion of broad and narrower QUDs addressed according to the complexity of the utterance (with or without theme). As can be seen, the proportion of broad QUDs increases when the utterance contains a theme. To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models differing only in the presence or absence of a fixed main effect of presence of theme. In both models, type of QUD (broad vs. narrow) was the dependent variable. The likelihood-ratio test showed a main effect of presence of theme ($\chi^2 = 8.39, p < .01$). Thus hypothesis 5 is borne out: the proportion of answers addressing the broad QUD is significantly higher when they contain a theme.

Finally let us now look at the data from the opposite perspective. Figure 6 shows the proportion of themeless and theme-containing utterances according to which QUD the speaker is addressing within the Simple Answer Condition. As can be seen, there is a difference between those cases in which the answer addresses the broad QUD and those in which it addresses a narrower QUD: the proportion of themes is larger when the QUD being addressed is the broadest one. To test for a main effect of condition, a likelihood-ratio test was conducted between mixed-effects models differing only in the presence or absence of a fixed main effect of QUD. In both models, theme presence/absence was the dependent variable. The likelihood-ratio test showed a main effect of QUD ($\chi^2 = 10.97, p < .001$). Thus hypothesis 6 is borne out: the presence of themes is significantly higher when speakers address the broad QUD as opposed to a narrower QUD.

The findings in Experiment 2 largely replicate those of Experiment 1: (i) when broad QUDs are addressed, the presence of themes increases and (ii) when themes are used, more broad QUDs are addressed. As found in Experiment 1, we can also observe that themes do not seem to be
necessary to address a broad QUD. That is, most of the answers addressing a broad QUD are themeless, as can be seen in Figure 6.

5. Discussion and conclusion

In this paper, the role of theme-containing utterances has been examined in connection to their ability to signal that the QUD being addressed is broader than the maximally prominent QUD at a particular point of the discourse. Two discourse-completion studies were carried out which confirm that, indeed, there is a relationship between presence of a theme and elaboration of a broad QUD. Participants produced more themes when addressing a broad QUD, as opposed to a narrower QUD. In addition, they also mostly addressed the broad QUD when their answer contained a theme.

We can, thus, conclude theme-containing utterances can flag the QUD being addressed is broader than the maximal one. However, it is also obvious that there is significant variation in the data and that the correlation between themes and broad QUDs is far from being a categorical one. One very striking result in both experiments is that, when broad QUDs are addressed, most answers are themeless (even if the proportion of answers with themes increases significantly). That is, while themes are a mechanism that can signal a shift to a broad QUD, they are not necessary to do so: it is possible to change the QUD even in absence of a linguistic marker. We believe that themes will tend to be absent when the broad QUD is deemed to be highly predictable by the speaker. That is, when a speaker is asking whether she should cook hake for Peter, it is obvious that it may be relevant to discuss Peter’s tastes. Therefore, the QUD ‘Does Peter like fish?’ is relevant for the conversation and, in effect, predictable. Given that the role of the theme is to prepare the context for an unexpected QUD, the more predictable the QUD is (even if it is not the maximally prominent one), the less necessary the presence of themes should be. Thus, the high number of themeless utterances in our data should not be surprising, given that in many occasions the QUDs they address can be considered to be highly predictable.

Related to this last point, it is worth mentioning that, looking at the data item by item, we can observe how the proportion of answers addressing the broad QUD varies greatly. Averaging the results from the two experiments, the proportion of answers addressing the broad QUD ranges from 16.5% to 87% depending on the item. That is, we find items on both ends of the scale (items for which the QUD addressed is almost always the broad one and items for which the QUD addressed is almost always the narrow one). Furthermore, the item distribution is fairly balanced throughout the scale, as can be observed in Table 1.

![Figure 6: Proportion of themes within the Large Context](image-url)
To understand the source of this distribution, we can observe the three items that triggered more answers to the broad QUD in (17) and the three items that triggered less answers to the broad QUD in (18). In both cases, the query is preceded by the Large Context in parentheses.

(17)  a. [Pere does not like fish.]
Li faig lluç, al Pere, per sopar?
‘Should I cook Pere some hake for dinner?’

b. [Carles never drinks alcohol.]
Li porto una cervesa, al Carles?
‘Should I bring Carles a beer?’

c. [Andreu hates touristy beach towns.]
Quedem amb l’Andreu a Salou?
‘Should we meet Andreu in Salou?’

(18)  a. [Roser used to be allergic to berries, but not anymore].
Li dono maduixes per postres, a la Roser?
‘Should I give Roser strawberries for dessert?’

b. [Sònia has been at the Louvre Museum multiple times.]
Li proposo d’anar a París, a la Sònia?
‘Should I ask Sònia if she wants to go to Paris?’

c. [Ariadna is at school every evening from 6 to 8.]
‘Li dic a l’Ariadna si vol anar al cine el dijous a les 6:30?’
Should I ask Ariadna if she wants to go to the movies on Thursday at 6.30?

In all items, the propositional content of the context entails a proposition by which we can infer the answer to the explicit query (i.e. ‘Carles never drinks alcohol’ entails ‘Carles never drinks beer’, which is useful to answer the query in (17b)). Then, why do we find such a different rate of answers addressing the broad QUD in (17) and (18)? We believe that the difference lies in the problem that (our participants imagined that) the questioner is trying to solve when she poses a query. For instance, when the questioner poses a query such as (17a), in fact, the problem she is trying to solve is what to give Pere for dinner. Under these circumstances, the person who is answering the query (in the Large Context) not only knows that Pere does not like hake, but has additional information that might be useful to solve the problem of the speaker: Pere does not like fish in general and this information is useful to eliminate other relevant alternatives. By offering an answer which elaborates on the broad QUD, the answerer is helping the questioner to find a solution to her problem. Something similar happens in (17b) and (17c), where the problems that we can imagine the questioner is trying to solve are what drink should she offer to Carles and where they can meet with Andreu, respectively. By giving an answer that addresses the broad QUD, the answerer is eliminating relevant alternatives and

<table>
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<th># of items</th>
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<tr>
<td>Less than 25%</td>
<td>3</td>
</tr>
<tr>
<td>Between 25% and 50%</td>
<td>6</td>
</tr>
<tr>
<td>Between 50% and 75%</td>
<td>4</td>
</tr>
<tr>
<td>More than 75%</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1: Number of items according to the % of answers addressing the broad QUD.
giving an answer that is more informative and helpful to resolve the problem of the questioner. In contrast, in the items of (18), either it is not as obvious which problem the questioner is trying to solve or the contextual information is not relevant to solve it. In (18a), given that the answer is positive (that is, Roser can eat strawberries), the problem is solved just by addressing the narrow QUD and it is not relevant that the answerer gives more information than necessary by addressing the broad QUD. In (18b), the information that Sònia has been in the Louvre Museum may eliminate Paris as a destination, but is not helpful to eliminate other alternatives. Finally, in (18c), it is possible that participants imagined a scenario in which the interlocutors have already decided to go to the movies at a particular day and time and they just need to find out whether Ariadna can join them or not. In this scenario, the details about Ariadna’s schedule are not relevant or helpful to solve the problem. To sum up, which QUD participants in a conversation decide to address at each moment crucially depends on the goal they believe the questioner has in posing the query.

To sum up, in this paper, we experimentally explored the understudied connection between the presence of a theme in an utterance and its ability to address a QUD broader than the most prominent one. The results for Catalan show that this connection clearly exists. One may wonder to what extent our results can be extended to other languages and, in particular, to languages without null pronouns, such as English. For a language like English, we would predict that we should find a difference in the type of subject present in the utterance: utterances with unstressed pronouns should behave like null pronouns and, thus, be more likely to answer a narrow QUD, while the presence of a more complex referential expression should correlate with an increase of elaborations of the broad QUDs. We leave it for future work to replicate this type of studies in other languages.

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Volume 2

Eds. Michael Franke, Nikola Kompa, Mingya Liu, Jutta L. Mueller, and Juliane Schwab

Osnabrück University
Humboldt University of Berlin
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Affirming and rejecting assertions in German Sign Language (DGS)

Cornelia LOOS – University of Göttingen
Markus STEINBACH - University of Göttingen
Sophie REPP – University of Cologne

Abstract. Response elements (REs) like English yes and no fulfill two functions. They may affirm or reject a previous utterance, or they may indicate that the response to the previous utterance has positive or negative polarity. In responses to negative sentences, these two functions come apart. Spoken languages investigated so far seem to display different preferences for the interpretation of REs to signal either the positive/negative polarity of the response clause or the affirmation/rejection of the truth of the previous utterance. The present paper investigates the meaning and use of REs in German Sign Language (DGS). We present the results of a discourse completion experiment in DGS, which is the first quantitative study of the response system of a sign language, and provide a preliminary theoretical analysis of this system. Sign languages are of particular interest in this context since they systematically use multiple articulatory channels, which can, in principle, encode truth and polarity at the same time. The results show that DGS employs manual and non-manual REs which encode both truth and polarity, i.e. are ambiguous, as well as REs that encode only truth. The ambiguous REs are used more often to encode truth than polarity, and are rarely disambiguated by simultaneous non-manual REs. Hence, DGS does not use the potential made available by the visual-gestural modality in the domain of response strategies.

1 Introduction

Response particles like English yes and no may serve two purposes when responding to assertions. They either affirm (yes) or reject (no) the truth of the asserted content, or they signal whether the response clause has positive polarity (yes) or negative polarity (no). In responses to positive assertions, those two functions coincide:

(1)  Antecedent: Pete has won the race.
     Response: a. Yes, he has. affirmation, positive polarity of response
               b. No, he hasn't. rejection, negative polarity of response

When the antecedent has negative polarity, an affirmative response also has negative polarity and a rejection has positive polarity. Since the two functions of the response particles no longer coincide, either particle can in principle be used to encode the intended meaning:

(2)  Antecedent: Pete hasn't won the race.
     Response: a. Yes/no, he hasn't. yes = affirmation, no = negative polarity
               b. Yes/no, he has. yes = positive polarity, no = rejection

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Languages seem to display different preferences for the use of response particles to signal affirmation/rejection vs. positive/negative polarity. Languages that affirm positive as well as negative assertions with \textit{YES}\textsuperscript{2} and reject them with \textit{NO} have traditionally been called \textit{truth-based languages}, while languages that mark the positive polarity of the response clause with \textit{YES} and negative polarity with \textit{NO} are known as \textit{polarity-based languages}. However, rather than follow one strategy exclusively, most languages exhibit a graded preference for one response strategy over the other (Pope, 1976; Jones, 1999; Roelofsen and Farkas, 2015). Some languages have particles that encode a combination of both functions. German \textit{doch} and French \textit{si}, for instance, encode both rejection and positive polarity (they would be appropriate in (2b)). Experimental investigations of a variety of languages confirm that preferences for a given response strategy are gradient rather than categorical (Brasoveanu, Farkas and Roelofsen, 2013; González-Fuente, Tubau, Espinal and Prieto, 2015; Meijer, Claus, Repp and Krifka, 2015; Li, González-Fuente, Prieto and Espinal, 2016; Claus, Meijer, Repp and Krifka, 2017; Goodhue and Wagner, 2015, 2018; Repp, Meijer and Scherf, 2019). Furthermore, there seems to be considerable inter-individual variation (Meijer et al., 2015; Claus et al., 2017; Repp et al., 2019).

The present paper addresses the issue of cross-linguistic variation by providing the first quantitative study of the response system of a sign language. We present data from a discourse completion task conducted in German Sign Language (DGS). The materials were adapted from Claus et al. (2017) to fit the requirements of a production experiment and were translated into DGS. The goal of the study was twofold. On the one hand, it aimed at eliciting the overall inventory of response elements used in DGS to respond to positive and negative assertions. We are using the term \textit{response element (RE)} to refer to any lexical item that is used as a short response to indicate truth or polarity, including particles. On the other hand, the current study aimed at investigating the usage patterns of \textit{YES} and \textit{NO} signs and their alignment with a truth- or polarity-based response strategy. Given that most DGS signers are bilingual to some extent (in DGS and German), contact-induced similarities between German and DGS may be expected. However, since there seems to be great inter-individual variation in German such that a majority of speakers prefer a truth-based response strategy and a minority prefer a polarity-based strategy or have no clear preference (Claus et al. 2017), the precise expectations with respect to the use of \textit{YES} and \textit{NO} in DGS are not so clear. Another contact-induced expectation is that DGS may have a dedicated RE for rejecting negative assertions comparable to German \textit{doch}.

The investigation of a signed language may shed new light on the meaning and use of REs since the visual-manual modality offers multiple visible articulatory channels that are used simultaneously and can in principle encode truth and polarity independently. For spoken languages, it has been shown that gestural components or components with a gestural origin such as head movement play a role in response systems (Esipova, 2019 for Russian; González-Fuente et al., 2015 for Catalan and Russian; Li et al., 2016 for Mandarin). For sign languages, we may hypothesize that non-manual markers such as head nods and head shakes have grammaticalized into REs that occur simultaneously with or replace manual response signs.

\textsuperscript{2} We are using italics plus small caps (\textit{YES, NO}) to refer to particles in other languages that correspond to English \textit{yes} and \textit{no}. 

The paper is organized as follows. Section 2 gives a brief overview of previous experimental findings on REs in English and German, which exemplifies cross-linguistic variation and illustrates the issues of gradable preferences and inter-individual variation. It then presents one of the theories that have been proposed to account for the meaning and use of REs. Section 3 reviews findings on non-verbal features that have been observed to typically accompany verbal REs in spoken languages. Section 4 specifies our expectations for the response system of DGS. Sections 5 and 6 present the discourse completion experiment. Section 7 offers a discussion and concludes.

2 Experimental findings on verbal REs and theories of REs

2.1 Experimental evidence

English responses show characteristics of a polarity-based response system, whereas the majority of German speakers employ response strategies that are closer to a truth-based system. As mentioned, the distinction between polarity-based and truth-based systems is not categorical. A comparison between English and German shows this very nicely. Both languages have been investigated in experimental studies where the acceptability of REs was tested in context-embedded dialogues, or where participants made a forced choice between yes and no. The experiments either tested bare particle responses or responses with a particle plus a response clause. The results are summarized in Table 1. We only report findings on responses to negative assertions since no virtually variation is attested in responses to positive assertions (which is expected). We are not considering negative questions as these were not tested in the current study.

For English, several varieties have been tested with slightly different results, which may be due to dialectal variation or/and to the partly different methodologies applied in the studies. Looking at US English, Brasoveanu et al. (2013) found in a forced choice experiment that in affirming responses, both yes and no are used but no is clearly preferred over yes. Goodhue and Wagner (2018) report that in an acceptability judgement study for Canadian English no was rated as more acceptable than yes, but yes still had medium acceptability with considerable variation in the judgements. The results for rejections of negative assertions are not very clear: there does not seem to be a difference between no and yes. Note, however, that in rejecting responses to negative questions, yes received higher acceptability ratings than no. Repp et al. (2019) report an acceptability study for UK English, where they observe a stark contrast in affirmations between the high acceptability of no and the low acceptability of yes. In rejections, yes overall was more acceptable than no but a quarter of participants rated both yes and no as acceptable.

Turning to German, Claus et al. (2017) found in an acceptability judgement study that in affirmations of negative antecedents the majority of participants found YES (ja) more acceptable than NO (nein). However, the overall ratings for NO were fairly high, and considerable inter-individual variation was attested. Across two experiments testing the acceptability of bare particle vs. particle-plus-full-clause responses to negative assertions, 25% of the participants consistently rated affirmations with NO as more acceptable than affirmations with YES, and another 8% rated both particles as equally acceptable. In
rejections, *doch* received higher acceptability ratings than *NO*, which received higher ratings than *YES*.

**Table 1. Preference patterns reported in the literature for YES and NO in response to negative assertions (e.g. Pete hasn’t won the race.)**

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<tr>
<th>Speech Act</th>
<th>English</th>
<th>German</th>
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<tr>
<td>Affirmation</td>
<td><em>…, he hasn’t</em></td>
<td><em>no &gt; yes</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>ja &gt; nein</em> (majority)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>nein &gt;/= ja</em> (minority)</td>
</tr>
<tr>
<td>Rejection</td>
<td><em>…, he has</em></td>
<td><em>yes &gt;/= no</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>doch &gt; nein &gt;&gt; ja</em></td>
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Overall the experimental findings show that although *YES* and *NO* may be used to express both of the functions that REs can have, there are different preferences in English and German. The preferences can differ in strength, i.e. acceptability is often graded. Finally, there is inter-individual variation, even to the extent that speakers have opposite preferences.

### 2.2 Theories of response elements

There are two main types of theoretical approaches to REs. The first type derives the meaning of *YES* and *NO* in the syntax by analyzing them as remnants of an elided response clause, which is syntactically identical with the antecedent clause. (cf. Van Cranenbroek, 2004; Kramer and Rawlins, 2011; Holmberg, 2013, 2015; Servidio, 2014; Servidio, Bocci and Bianchi, 2018). The second approach generates the meaning of REs at the interface between semantics and pragmatics. Its proponents treat *YES* and *NO* as anaphoric expressions that pick up a proposition introduced by the antecedent clause (Krifka, 2013; Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2019). In this paper, we focus on one of the anaphoric approaches, the so-called *feature model* (Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2019), because this model avoids certain problems encountered by the syntactic accounts (see Claus et al., 2017 for discussion). Furthermore, certain premises of the other semantic-pragmatic account concerning the saliency of the negative and positive propositional discourse referents that are introduced by a negative sentence (Krifka 2013) may not be correct (Claus, Frühauf and Krifka, 2019; also see Farkas and Roelofsen, 2019, for a critical discussion of Krifka, 2013).

The feature model is a linear optimality-theoretic account. In linear optimality theory, constraints are weighted, and non-optimal candidates are not ungrammatical but dispreferred, so that graded acceptability can be modelled (cf. Keller 2000). The feature model derives its name from the fact that it treats REs as the morphological expressions of two types of polarity features that occur on a polarity head in the syntactic structure of a response. The polarity head takes a TP as its complement, which denotes the so-called *prejacent* and can be elided. Both types of polarity features are semantic in nature and purely presuppositional. The first type are the absolute polarity features [+] and [–]. They presuppose that the polarity of the prejacent is positive [+] or negative [–]. The second type are the relative polarity features [AGREE] and [REVERSE]. They presuppose the existence of a unique salient discourse referent in the immediately preceding discourse whose interpretation and polarity are identical with (i.e. [AGREE]) or the opposite of (i.e. [REVERSE]) that of the prejacent.
Cross-linguistic variation in the distribution of \textit{YES}- and \textit{NO}-responses as well as gradient preferences within a language are explained as arising from language-specific feature–RE mappings in conjunction with language-specific optimality-theoretic constraint rankings. The feature–RE mappings are regulated via \textit{feature-mapping rules}. These determine which features or feature combinations map onto which RE. For instance, a language may map [+\textit{AGREE}] onto \textit{YES}, another language may map [+\textit{AGREE}] and [\textit{AGREE}] onto \textit{YES}, some languages may map the combination [+\textit{AGREE}, \textit{REVERSE}] (rejecting a negative antecedent) onto a RE, as is the case for German \textit{doch}. The relevant optimality-theoretic constraints are the following:

\begin{itemize}
  \item \textbf{MAXIMIZE RELATIVE}: Maximize the realization of relative polarity features.
  \item \textbf{MAXIMIZE ABSOLUTE}: Maximize the realization of absolute polarity features.
  \item \textbf{MAXIMIZE MARKED}: Maximize the realization of marked polarity features or feature combinations.
  \item \textbf{EXPRESSIVENESS}: Maximize the expression of feature content.
\end{itemize}

MAXIMIZE RELATIVE and MAXIMIZE ABSOLUTE specify that a certain type of feature has a high realization need, i.e. must be expressed by a RE. MAXIMIZE MARKED is an instantiation of the general pressure to realize marked features over unmarked features (Horn 1984). The features [\textit{-}], and [\textit{REVERSE}] are considered marked features. The markedness of [\textit{-}] is motivated by the assumption that negative sentences arguably are more difficult to process than positive sentences. [\textit{REVERSE}] is more marked than [\textit{AGREE}] because the complement relation is more complex than the identity relation and disagreeing with someone is dispreferred as a conversational move. The feature [+\textit{AGREE}] is marked in the feature combination [+\textit{AGREE}, \textit{REVERSE}] because it contrasts with the polarity of the antecedent. EXPRESSIVENESS maximizes the amount of information that is expressed by a form, which for the choice of a RE essentially means that REs which express feature combinations are preferred over REs that express only one feature. Finally, Roelofsen & Farkas (2015) assume that it is pragmatically advantageous to avoid ambiguous expressions.

Let us illustrate the mapping rules and the interaction of the optimality-theoretic constraints for English and German. In both languages, [\textit{AGREE}] and [+\textit{AGREE}] map onto \textit{YES}, [\textit{REVERSE}] and [\textit{-}] map onto \textit{NO}. In German, there is an additional mapping of [\textit{REVERSE}, [+\textit{AGREE}]] onto \textit{doch}. Looking back at the English dialogue in (2), concretely at the affirmation of the negative assertion in (2a), both \textit{yes} and \textit{no} are allowed by the feature mapping for English: \textit{yes} can be used because it encodes [\textit{AGREE}] and \textit{no} can be used because it encodes [\textit{-}]. However, by MAXIMIZE MARKED, \textit{no} should be preferred because it realizes a marked feature. As we saw above, this is indeed what has been found for the acceptability of English \textit{no} and \textit{yes} as affirmations of negative antecedents. For German, the feature mapping for (2a) is the same, but we saw in the previous section that the majority of speakers find \textit{YES} more acceptable than \textit{NO} in such contexts. This can be explained if MAXIMIZE RELATIVE is assigned a higher weight than MAXIMIZE MARKED for those speakers (Farkas and Roelofsen, 2019). If we wish to express this in terms of constraint ranking rather than constraint weights, we could say that MAXIMIZE RELATIVE is ranked higher than MAXIMIZE MARKED (Claus et al., 2017). For English, Repp et al. (2019) propose that MAXIMIZE RELATIVE is essentially not operative (i.e. ranked very low). Rather, MAXIMIZE ABSOLUTE is ranked very highly, higher than MAXIMIZE MARKED. This assumption accounts for the general preference of \textit{yes} over \textit{no} in rejections of negative antecedents observed by Repp et al. Note that in affirmations, where \textit{no} is preferred over \textit{yes},
no encodes [–], i.e. an absolute feature, which further supports the high ranking/ great weight of MAXIMIZE ABSOLUTE in English. Finally, in German, EXPRESSIVENESS ranks highest/ has the greatest weight: EXPRESSIVENESS >> MAXIMIZE RELATIVE >> MAXIMIZE MARKED. This ranking accounts for the preference of German doch ([REVERSE, +]) over NO and YES in rejections, which express fewer features. This ranking also accounts for NO ([REVERSE]) being preferred over YES ([+]).

3 Gestural response strategies

The present study stands out as the first larger-scale production experiment on any language systematically eliciting a wide range of REs. Previous free production experiments on spoken languages are reported in Li et al. (2016) on Mandarin Chinese and González-Fuente et al. (2015) on Catalan and Russian. Both studies employed a discourse completion task to elicit semi-spontaneous responses to assertions and questions. Li et al. tested rejecting responses only. In addition to the use of REs, both studies recorded prosodic and gestural components of their participants’ responses. Participants read a scene-setting passage, then listened to an audio-recorded target sentence (a question or an assertion) and provided a response congruent with the information they received in the scene-setting passage. Their responses were video-recorded.

With respect to the REs that were produced, Li et al. observe for Mandarin Chinese that only NO-type REs occur in rejections of negative antecedents. In terms of the feature model, this means that Mandarin Chinese assigns great weight to MAXIMIZE RELATIVE. González-Fuente et al. observe for Catalan that rejections to negative antecedents were primarily encoded with YES (sí), which could be followed by a clause or not. NO (no) was attested in 8% of the rejections but occurred only in combination with sí, e.g. No, sí que ha vingut (lit.: no si that has come, ‘No, he has come’). In other words, even in these responses, the absolute polarity feature is overtly expressed. In affirmations of negative antecedents, mostly YES is used. In terms of the feature model, these results suggest that Catalan assigns great weight to MAXIMIZE ABSOLUTE. Russian also assigns great weight to MAXIMIZE ABSOLUTE, but this can only be observed in affirmations of negative antecedents, where NO (нет) occurs in 80% of the responses. In rejections of negative antecedents, only NO occurs. It seems that YES (да) in Russian only encodes [AGREE] and not [+].

Since we are interested in the potential overlap of non-manual REs in sign languages and gestural REs in spoken languages, let us turn to the results for these studies for non-manual gestures accompanying YES and NO. Both studies coded head movements (head nods, head shakes, tilt, turn), eyebrow raises and shoulder shrugs. Li et al. (2016) also coded eyebrow furrowing and movement of the corners of the mouth. Since Li et al. were mainly interested in rejections in Mandarin, their analysis of gestures compared rejections with dialogue turns that were a neutral assertion. The gestures were coded both for responses with NO and for responses without NO, i.e. for responses that consisted of a positive response clause only. Li et al. found that overall, gestural elements were more frequent in rejections than in assertions (48% vs. 4%). In rejections, head nods were considerably more frequent than head shakes. Head nods occurred in 30% of the rejections with NO and in 24% of the rejections without NO.

3 Compared to the current study, the scale and statistical power of these studies is rather small: The data come from 8 speakers of Mandarin Chinese, and 4 speakers of Russian and Catalan each.
Head shakes occurred in 4% and 7%, respectively. Li et al. interpret the head nod as being an expression of a `REJECT` operator, which needs no verbal lexical expression, i.e. it may simply combine with a positive response clause. Since rejections of positive sentences were not tested, it is difficult to judge if the head nod encodes `[+]` for the positive response clause or `[REVERSE]` signalling the rejection.

González-Fuente et al. (2015) only investigated gestures that occurred simultaneously with a RE. They found that both in Russian and in Catalan, gestures were more frequent and/or more emphatic in rejections of negative antecedents than in affirmations of positive antecedents. The contrast was especially strong in eyebrow movement; eyebrow raising occurred in 92% of the rejections of negative antecedents in Catalan (80% in Russian), but only in 57% (38% in Russian) of the affirmations of positive antecedents. Furthermore, like in Mandarin, head nods were the most common head movement when rejecting a negative antecedent in Catalan and Russian, but head nods also frequently accompanied affirmations of positive antecedents. In Catalan, the head nod thus seems to express the same feature as the verbal element `si`, 'yes': `[+]`. We will call this phenomenon concord here: two elements express the same feature. For Russian, Esipova (2019) argues that `[AGREE]` and `[+]` map onto a head nod while `[REVERSE]` and `[–]` map onto a head shake. Since the head nod thus fills a gap in the Russian response paradigm, which has no RE encoding `[+]`, she proposes that head movements should be treated as linguistic objects proper. They lexicalize independently of the inventory of REs in a language. Esipova also looks at sequential combinations of head movements and lexical REs in Russian and notes (i) a preference for realizing relative polarity features before absolute features and (ii) that head nods encode different features when occurring alone vs. when accompanying a lexical RE. The former seem to only encode `[AGREE]`, while the latter can also encode `[+]`.

4 Response strategies in the visual-gestural modality: Expectations about DGS

Sign languages use various articulators at the same time to express different aspects of meaning simultaneously (Meier, 2002; Aronoff, Meir and Sandler, 2005). Therefore, the interaction of manual and non-manual markers of polarity and truth is especially interesting: DGS could in principle express both truth and polarity manually and non-manually. These manual and non-manual markers can either be used in combination or in isolation. Casual observation suggests that in DGS, the manual sign `ja` 'yes' is typically accompanied by a head nod while the sign `nein` 'no' is often accompanied by a head shake. While typically considered lexical components of the respective response sign, the two head movements can also be detached from the corresponding manual elements and can be used in isolation. In addition, sentential negation in DGS is obligatorily expressed via a negative head shake that heads a NegP and may spread over (parts of) the corresponding clause (Pfau 2008). DGS is thus a non-manual dominant language, i.e. a language that can express negative polarity only with the non-manual head shake (Pfau and Quer, 2002; Zeshan, 2004). Given these observations, we expect DGS to use manual and non-manual markers in response clauses with a preference for the use of non-manuals for expressing negative polarity.

Another prediction for DGS is that it may express polarity and truth simultaneously with a manual and a non-manual marker. In Section 3, we discussed this option for spoken language

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4 Following sign language glossing conventions, DGS signs are written in (non-italicized) small caps.
and gesture. However, unlike spoken languages, sign languages are well-known for integrating non-manual components into their grammatical system to express various syntactic, semantic and pragmatic features such as in negation, sentence types and information structure (Pfau and Quer, 2010, Wilbur, 2012). Therefore, we expect a systematic interaction of non-manual markers with manual REs in DGS. Concretely, we may formulate the following contrasting predictions. Given that clausal negation is preferentially expressed with a head shake, there might be a response strategy for affirmations of negative antecedents that maps [−] onto a head shake and [AGREE] onto the manual JA. This would result in disambiguation if JA is indeed ambiguous. In contrast, headshakes might not co-occur with JA if we assume there to be *concord* between manual and non-manual elements: head shakes are likely to combine with NO-type markers and head nods with YES-type markers, or in other words non-manuals and manuals might encode the same features. We will see that this second prediction is borne out by the data. As for other non-manual markers, like brow movements, our study is exploratory. Given the results for Catalan and Russian, where brow movements are gestures that frequently occur in rejections of negative antecedents, we may in principle expect that brow movements may also be used for such a purpose in a sign language.

Since we conducted a free production study (similarly to Gonzales-Fuente et al., 2015 and Li et al., 2016), we further expect that other REs than YES and NO will be used. DGS inter alia has the manual signs STIMMT (lit: *be.correct*, 'that's correct') and FALSCH ('wrong'), whose translation equivalents in German unambiguously encode the relative features [AGREE] and [REVERSE]. Yet these REs have not been investigated systematically in quantitative investigations, so we know little about their use. It might well be the case that unambiguous REs are used more often after negative antecedents than after positive antecedents because ambiguity could be avoided this way – in spoken languages as well as in sign languages.

A final point is language contact. In DGS, one prominent area of influence of spoken German is mouthing. DGS uses mouthing in various contexts, either as an additional non-manual phonological feature of a sign (especially with nouns and verbs) or to disambiguate manually ambiguous signs (Boyés Braem and Sutton-Spence, 2001). So DGS has the potential to combine manual and non-manual REs with a specific mouthing borrowed from German. The mouthing may correspond to the meaning of the RE (i.e. ja 'yes' and nein 'no'), which would be an instance of concord. Alternatively, it may specify another RE. An example for the latter would be the use of the mouthing *doch* in combination with JA or NEIN or a non-manual RE to express the feature combination [REVERSE, +]. Finally, a signer may use mouthings in isolation as a reaction to positive and negative antecedents. Such uses may either be analyzed as an instance of language switch or as the omission of the corresponding manual material.

5 Discourse completion task: Method

The experiment in this study used the same materials as the acceptability studies for German reported in Claus et al. (2017). There were some adaptations of the materials to fit the lexical needs of DGS and to provide culturally appropriate contexts for the DGS community. Participants in the study watched short video sequences in DGS and engaged in dialogues with a person in the video while they were being video-recorded themselves. The participants' task was to complete each dialogue by producing a polar response to a negative
or positive assertion made by the person in the video. Participants were free in their choice of
words. This method enabled us to answer the research questions raised in the introductory
section: (i) What is the inventory of REs in DGS? (ii) What response strategies are used in
responses to negative assertions, where the two functions that the REs YES and NO in principle
fulfil come apart? (iii) How do manual and non-manual markings combine?

**Participants.** 24 (near-) native signers of DGS\(^5\) (18 to 55 years, \(M = 32\), 6 male) participated
in the experiment either at the University of Cologne or at the University of Göttingen.
Fourteen signers live in North Rhine Westphalia, four in Berlin, three in Hesse, and one in
Lower Saxony. All participants evaluate their command of German as at least good. They
were reimbursed for their participation.

**Materials and design.** The study contained 48 experimental items (lexicalizations) and one
practice item. Each item started with a native signer of DGS narrating a situation involving
the two characters Peter and Alex. Then Peter, played by another native DGS signer,
appeared in the video, facing the participant. He made an assertion. Participants were asked
to take the role of Alex and produce a polar response to Peter's assertion. The information for
responding truthfully to the assertion was always given in the narrator's description of the
situation. Peter's assertion had either positive or negative polarity (factor: antecedent). The
participants' responses either affirmed or rejected Peter's assertion (factor: speech act). The
experiment thus had a \(2 \times 2\) design resulting in four experimental conditions. The items were
distributed over two lists. The factor antecedent was manipulated within participants and
between items: 24 of the lexicalizations contained a negative assertion, 24 contained a
positive assertion. All participants saw all lexicalizations. The factor speech act was
manipulated within items and between participants: which assertions were affirmed and
which were rejected varied systematically over the two lists. The order of items in each list
was pseudorandomized and presented in regular or in reversed order. A sample item is shown
in (3). Here participants are expected to reject a negative assertion.

(3) **Narrator:** Peter and Alex are elementary school teachers. They are organizing a
school party with the help of some of the parents. Alex just learnt that the
parents have already bought the beverages. A little later, Peter and Alex
discuss the tasks assigned to the parents.

**Peter:** The parents haven't bought the beverages yet. \(\text{ (negative assertion)}\)

All assertions were transitive sentences. Positive assertions contained the temporal adverbial
FRÜHER 'before, in the past' while negative assertions contained the negator NOCH-NICHT 'not
yet'.

**Procedure.** Participants were welcomed by a proficient or a native signer in DGS. They sat
in front of a computer screen and received instructions by watching a video in DGS. In the
video, another proficient DGS signer explained the task with the help of a sample item and a
number of possible response elements. Participants were encouraged to respond
spontaneously as if they were having a natural conversation. After a practice trial, they
received feedback before starting the experiment. They moved through the experiment at
their own pace, advancing via mouse-click. They were recorded by a video camera located

\(^5\) Age of acquisition of DGS at or before age 5.
next to and slightly above the computer screen. One experimental session lasted approximately two hours and participants were instructed to take breaks as needed.

6 Discourse completion task: Results

The data were annotated in ELAN (Wittenburg et al., 2006) for the presence and type of RE(s) that were produced as well as accompanying non-manuals, specifically mouthing, head nod and head shake, as well as brow raise and brow furrow. Of the 1152 recordings, 871 (75.6%) could be used for analysis. Two recordings were excluded because of technical problems. 72 items (6.3%) were excluded due to high error rates: in the three lexicalizations these items occurred in (3 × 24 participants), the signs proved not to be sufficiently conventionalized. A further 90 items (7.8%), produced by two participants, were excluded because the participants did not perform the task they were asked to perform. One participant was not engaging in the conversation but commented on whether or not the claim produced in the antecedent clause was correct. The other participant did not respond to the antecedent but retold the situation. Finally, any remaining items where the answer clearly was not correct were excluded (117 items, 10.2%). Whether or not an answer was correct was decided on the basis of what the participant uttered after a RE, e.g. an explicit response clause.

Participants produced up to four utterance-initial REs, which were regularly followed by further linguistic material: a response clause or an explanation. Utterance-final REs were also produced – also up to four. In the following, we only present results for the first and the second utterance-initial RE (henceforth RE1 and RE2). For the statistical analysis, we fitted general linear mixed effects models with a binomial logit function (R package lme4, Bates, Mächler, Bolker and Walker, 2015). The p-values that we report for these data are based on the Kenward-Roger approximation (lmerTest; Kuznetsova, Brockhoff and Christensen, 2017). Antecedent and speech act were fixed factors. Both factors were sum-to-zero contrast coded. Participant and lexicalization were random factors. Where possible (i.e. in the absence of convergence problems), we fitted maximal models including slopes for the random factors. Below we indicate the type of model by abbreviations, e.g. m\text{int} for model with only intercepts, m^{p-sl:SA} for model with participant slope for speech act (and with intercept for lexicalization).

6.1 The first response element (RE1)

759 utterances (87.1%) contained at least RE1. There were more RE1 in affirmations than in rejections (88.8% vs. 85.4%; b = -0.22, SE = 0.11, z = -2.04, \( p < 0.05 \); m^{p-sl:A}). Participants used thirteen different manual RE1, three of which occurred only once. A manual RE1 could be accompanied by non-manuals or not. Participants also used non-manuals without a manual as RE1. There were seven different such non-manual RE1, two of which occurred only once. Figure 1 gives an overview of the distribution of the different RE1 across the conditions. It shows that signers regularly produced REs that seem to express only the relative feature [AGREE]: these REs only occur in affirmations, e.g. STIMMT (‘that's correct’). Signers also regularly produced REs that seem to express only the relative feature [REVERSE]: these REs only occur in rejections, e.g. STIMMT-neg (‘that's not correct’) or various signs for FALSCH (‘wrong’). There were two REs that correspond to German doch: they only occurred in rejections of negative utterances. These were the manual DOCH (\( n = 2 \)) and the mouthing doch
Figure 1. RE1 produced in the discourse continuation task. Green colours indicate that the RE was used unambiguously as an affirming RE, red colours mark unambiguously rejecting REs, other colours mark ambiguous elements with lighter shades indicating a YES-similarity and darker shades indicating a NO-similarity. 'M' indicates that the RE is a mouthing. 'H' means that the RE is a head movement.

(n = 11). The mouthing stimmt was the only RE1 that occurred only in affirmations of negative antecedents (n = 5). Many RE1 were ambiguous, e.g. JA ('yes'), the head nod, NEIN ('no'), NEE.5Hand ('no'), and the headshake. Below we detail the results for those ambiguous RE1 that were produced in a sufficiently high number to allow generalizations about their meaning and use. Table 2 gives an overview of the frequency of occurrence for these RE1.

Table 2. Distribution of ambiguous RE1 that are used frequently (total counts | proportion in the relevant speech act: columns add up to 100% together with non-frequent ambiguous and with unambiguous RE1; standard deviation between brackets)

<table>
<thead>
<tr>
<th>RE1</th>
<th>Total</th>
<th>positive antecedent</th>
<th>negative antecedent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>affirmation</td>
<td>rejection</td>
</tr>
<tr>
<td>JA</td>
<td>212</td>
<td>117</td>
<td>.61 (.49)</td>
</tr>
<tr>
<td>NEIN</td>
<td>126</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NEE.5Hand</td>
<td>44</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>head shake</td>
<td>46</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The manual marker JA occurred in affirmations of positive antecedents, and in affirmations and rejections of negative antecedents. We fitted a model for negative antecedents only. After negative antecedents, JA occurred marginally more often in affirmations than in rejections (b = -2.15, SE = 1.15, z = -1.87, p = 0.06; m30). Thus, JA seems to encode [AGREE] as well as [+], with a preference for [AGREE]. The manual marker NEIN occurred in rejections of positive
antecedents, and in affirmations and rejections of negative antecedents. We tried to fit a model for negative antecedents, which only converged when item was removed as a random factor. By this model, NEIN occurred more often in rejections than in affirmations ($b = 3.46, SE = 1.44, z = 2.39, p < 0.05; \text{mp.int}$). Hence, NEIN seems to encode [REVERSE] as well as [−], with a preference for [REVERSE]. The other, less frequent RE1 that potentially are NO-elements, i.e. the manual NEE.5Hand and the head shake are similar to NEIN in their distribution. All these elements seem to be able to express [REVERSE] and [−], with a preference for the realization of [REVERSE].

To further investigate the role of ambiguity in the choice of RE1, we pooled all ambiguous RE1 (YES-/NO-type) and compared their frequency of occurrence with the pooled unambiguous RE1. Figure 2 indicates that except in affirmations of negative antecedents, ambiguous RE1 were produced more frequently overall than unambiguous RE1. The statistical analysis of the frequency of choice of ambiguous RE1 revealed that participants produced fewer ambiguous RE1 after negative than after positive antecedents ($b = -0.50, SE = 0.19, z = -2.61, p < 0.01; \text{mp.int}$).

6.2 Non-manuals on RE1

Out of the 759 manual RE1, 698 (92.0%) co-occurred with at least one simultaneous non-manual marker. Overall, there were more RE1 accompanied by at least one non-manual in affirmations than in rejections (94.8% vs. 89.1%; $b = -0.53, SE = 0.17, z = -3.11, p < 0.01; \text{mp.sl:A}$) but the different non-manuals showed different distributions.

343 RE1 (45.2%) were produced with simultaneous mouthing. Mouthings occurred more often after negative than after positive antecedents (50.1% vs. 39.6%, $b = 0.35, SE = 0.16, z = 2.19, p < 0.05; \text{mp.sl:SpA+A}$).

479 RE1 (63.1%) occurred with a head movement. There were more RE1 with a head movement in rejections than in affirmations (69.8% vs. 56.5%; $b = 0.40, SE = 0.20, z = 2.04, p < 0.05; \text{mp.sl:SA+A}$). There were 229 head nods (32.8%) and 250 head shakes (33.0%). Figure 3 illustrates the distribution of nods and shakes in the experimental conditions.
conditions. After positive antecedents, RE1 with head nods occurred only in affirmations, and RE1 with head shakes only in rejections. After negative antecedents, nods and shakes occurred in both speech acts but with different frequencies. After negative antecedents, nods occurred more often in affirmations than in rejections \((b = -1.69, SE = 0.44, z = -3.81, p < 0.001; \text{m}.\text{sl}:\text{SpA})\); head shakes occurred more often in rejections than in affirmations \((b = 2.2218, SE = 0.3123, z = 7.113, p < 0.001; \text{mi}.\text{sl}:\text{SpA})\).

217 RE1 (31.1%) were produced with a brow movement. There were 91 brow raises (13.0%) and 126 brow furrows (18.1%). Figure 4 illustrates their distribution over the experimental conditions. For RE1 with brow raises, there was a main effect of the factor antecedent \((b = 0.54, SE = 0.16, z = 3.47, p < 0.001)\), which was modulated by an interaction of antecedent and speech act \((b = 0.59, SE = 0.15, z = 3.79, p < 0.001; \text{m}.\text{int})\). Resolving this interaction revealed that the effect of antecedent was not significant for affirmations. For rejections, even a model with only random intercepts was a singular fit. Removing item as a factor resulted in a model by which there were more RE1 with a brow raise in rejections after negative antecedents than after positive antecedents \((b = 1.17, SE = 0.25, z = 4.76, p < 0.001; \text{m}.\text{int})\). For RE1 with brow furrows, the random factor item also was removed to avoid a singular fit \((b = 1.64, SE = 0.57, z = 2.86, p < 0.01, \text{m}.\text{sl}:\text{SpA})\). By this model, there were more RE1 with brow furrows in rejections than in affirmations.

To further investigate the combination of RE1 with a non-manual, we explored which types of manual markers (in terms of their semantic-pragmatic function) were combined with the various non-manuals. Recall from Section 4 that manual and non-manual markers can in principle be used to express different features simultaneously. Therefore, we were particularly interested in whether or not manual and non-manual marker show concord, i.e. encode the same or different features.

Mouthings on RE1 overwhelmingly showed concord: 297 out of the 343 RE1 with mouthing (86.6%) were of the same type, i.e. both signalling [AGREE] \((n = 125)\), both signalling [REVERSE] \((n = 119)\) or both being principally ambiguous, that is being YES-type \((n = 39)\) or NO-type \((n = 15)\). There were two kinds of non-concord. First, a [REVERSE]-type RE1 was accompanied by an [AGREE]-type mouthing 11 times. All these occurrences were combinations of the manual STIMMT-neg ('that's not correct') with the mouthing stimmt ('that's correct') i.e. the mouthing did not express the negation. This is not unexpected given that mouthings are frequently truncated variants of the spoken language signal from which they are borrowed. Eight of these combinations occurred in rejections of positive antecedents, three occurred in rejections of negative antecedents. Second, a YES-type RE1 was accompanied by a [REVERSE]-type mouthing 20 times. All these were combinations of the manual JA with the mouthing doch, and they occurred in rejections of negative antecedents. Other combinations were spurious.
Head movements on RE1 showed complete concord with RE1 after positive antecedents. After negative antecedents, there mostly was concord but there was one systematic exception (see the end of this paragraph) as shown in Figure 5. In affirmations of negative antecedents [AGREE]-type RE1 occurred with head nods 59 times and with a head shake only once, YES-type RE1 occurred with head nods 33 times and with a head shake only once, NO-type RE1 occurred only with head-shakes \((n = 12)\). In rejections of negative antecedents, NO-type RE1 occurred only with head shakes \((n = 55)\), and yes-type RE1 only occurred with head nods \((n = 16)\). [REVERSE]-type RE1 occurred with a head shake 53 times, and with a head nod 11 times. The last combination is the one systematic non-concord combination. 10 of these 11 cases involved a non-manual RE1, namely the mouthing `doch`. The 11th case involved the manual marker DOCH. Of the 20 combinations of a YES-type RE1 (JA) with the mouthing `doch` (see above), 14 were additionally accompanied by a head nod, i.e. the head nod showed concord with RE1 and the mouthing showed non-concord.

The type of brow movement did not seem to correspond directly with a certain type of RE1, see Figure 6. Still, in rejections, where brow movements were most frequent, they mostly occurred on NO-type RE1. And on these, brow furrows seemed to occur more often than did brow raises.

6.3 Combination of RE1 and RE2

160 utterances (18.4% of all utterances, 21.1% of utterances with RE1) contained a second RE (RE2). Descriptively, there were more RE2 in affirmations (30.1%) than in rejections (12.2%). Since even the simplest model with all random factors was a singular fit, we fitted a
model without the factor item, which confirmed the descriptive observation \( (b = 0.63, \text{SE} = 0.10, z = 6.12, p < 0.001; m^{\text{lm}}) \). Participants used eight different manual RE2 and one mouthing ('ja 'yes'), see Figure 7. By far the most frequent RE2 was the manual STIMMT 'that's correct' \( (n = 97, 60.1\% \text{ of RE2}) \).

**Relation between RE1 and RE2.** There were 37 different combinations of RE1 and RE2. The most frequent combinations were those involving STIMMT. In affirmations of positive antecedents, STIMMT followed JA 43 times and a head nod 7 times. In affirmations of negative antecedents, STIMMT followed JA 38 times, a head nod once, the mouthing ja once, and a head shake 3 times. To assess the potentially disambiguating role of RE2, we coded all RE1 and RE2 for ambiguity. RE2 has a potentially disambiguating function when it follows an ambiguous RE1 and is itself non-ambiguous. RE2 had this potential function more often in affirmations than in rejections \( (b = -0.93, \text{SE} = 0.35, z = -2.70, p < 0.01; m^{\text{sl}}A \times SpA) \). This effect most probably is a consequence of the frequent occurrence of STIMMT after yes-type RE1, which is only appropriate in affirmations. Notably, there was no effect of antecedent whatsoever and no interaction \( (z < 0.36, p > 0.7) \). Whether or not non-ambiguous RE2 occurred more often after ambiguous vs. non-ambiguous RE1 in the different conditions could not be tested statistically due to the low number of data. Descriptively, a non-ambiguous RE2 followed an ambiguous RE1 more often than it followed a non-ambiguous RE1 (86.5\% vs. 44.4\%) but to what extent this interacts with speech act or antecedent needs to be tested in future research.

As for concord between RE1 and RE2, there were 7 instances of non-concord combinations. In affirmations of a negative antecedent there was [AGREE]_{RE1} + NO-type_{RE2} \( (n = 1, \text{STIMMT + NEE.5Hand}) \), and no-type_{RE1} + [AGREE]_{RE2} \( (n = 3; \text{head shake + STIMMT}) \). In rejections of negative antecedents, there was [REVERSE]_{RE1} + yes-type_{RE2} \( (n = 3, \text{mouthing doch + JA}) \).

### 7 General discussion and conclusion

The discourse completion experiment shows that DGS signers use a wide variety of both manual and non-manual REs. Concentrating on RE1 alone, we found that some REs are unambiguous because only one polarity feature maps onto them. For instance, only [AGREE] maps onto STIMMT, and only [REVERSE] maps onto FALSCH. Furthermore, there are feature combinations that map onto a RE1: [+ , REVERSE] maps onto the mouthing doch and onto the manual DOCH but these RE1 were used infrequently. Other RE1 are ambiguous because two polarity features map onto them. Both [+ ] and [AGREE] map onto JA and onto the head nod, but head nods were infrequent without a manual RE1. Both [− ] and [REVERSE] map onto NEIN, onto NEE.5Hand and onto the head shake.
Regardless of the articulator which produces them, ambiguous REs preferentially realize relative features. This suggests that MAXIMIZE RELATIVE is assigned great weight in DGS and that the head shake and the head nod are subject to this constraint. With respect to the head shake, this finding is surprising because the head shake also expresses sentential negation [−], i.e. negative polarity. This was not the case. Overall, it seems that DGS is quite similar with respect to the high ranking of MAXIMIZE RELATIVE to the ambient contact language German, but recall that we do not have data yet about head movements in German. In any case, DGS seems to differ from the spoken languages reviewed in Section 3 in its use of the head nod. Mandarin, Catalan and Russian regularly use head nods in rejections with or without verbal REs, which is not the case in DGS.

EXPRESSIVENESS seems to be a constraint with small weight in DGS – certainly with a smaller weight than in German. In rejections of negative antecedents, the most frequent response strategies were NO-type REs (NO, NEE, Hand, head shake), which only realize [REVERSE] in these contexts, and unambiguous [REVERSE]-type REs (STIMMT-neg, STIMMT-NICHT, FALSCH). As already mentioned, REs that express the feature combination [+REVERSE] – mouthing doch and DOCH – were rare. Still, from the point of view of language contact it is notable that doch-like REs did occur, clearly suggesting influence from German. What is also notable in this context is that the two occurrences of the manual DOCH were accompanied by a head nod, which plausibly realizes [+] in rejections of negative antecedents. Exactly the same combination of feature realizations occurred in the more frequent combinations of JA [+] with mouthing doch [+, REVERSE]. As a matter of fact, 20 out of 24 occurrences of JA in rejections of negative antecedents were accompanied by this mouthing. This suggests that JA on its own is not regularly used as a rejection. Note that if combined with DOCH/doch, JA and the head nod most likely are redundant: DOCH/doch never occurred after positive antecedents, i.e. DOCH/doch cannot be purely rejecting and only encode [REVERSE]. Combinations of a RE1 with a non-manual such that one element expresses [+REVERSE] and the other [REVERSE], e.g. a head nod combined with STIMMT-neg did not occur, except for the combination of STIMMT-neg with the truncated mouthing stimmt. We do not consider the latter as a realization of [+REVERSE]. Neither did combinations occur where one element expresses [−REVERSE] and the other [AGREE], e.g. a head shake combined with STIMMT. In sum, these findings suggest that following preference order for REs in rejections of negative antecedents: NO-type RE > [REVERSE]-type > [+REVERSE]-type > YES-type. An evaluation of this finding in terms of the feature model is a challenge because the realization of [+REVERSE] by DOCH/doch violates no constraint that the realization of [REVERSE] would not also violate if MAXIMIZE RELATIVE has great weight in DGS, for which there is plenty of evidence. Neither a realization of [+REVERSE] nor of [REVERSE] violates MAXIMIZE RELATIVE or MAXIMIZE MARKED; EXPRESSIVENESS penalizes [REVERSE] rather than [+REVERSE]. For the time being we are assuming that there might be a lexicalization issue here: only few speakers use DOCH/doch at all so that these REs do not enter the candidate space for an optimality-theoretic evaluation.

The finding that in rejections of negative antecedents, NO-type and [REVERSE]-type RE1 were equally frequent may be considered surprising from the point of view of ambiguity avoidance: if ambiguity is to be avoided, [REVERSE]-type REs should be more frequent than NO-type REs. Considering that NO-type REs probably are used in responses to polar questions
whereas [REVERSE]-type RE plausibly are not, NO-RES might be used regularly after assertions simply because they are very frequent REs anyway. This issue needs to be tested in future research. Still, we did find some evidence for the pressure to avoid ambiguity. Overall, ambiguous RE1 were used less frequently after ambiguity-inducing negative antecedents than after positive antecedents. Furthermore, we found that in affirmations, JA was often followed by a disambiguating [AGREE]-RE2. Although this combination occurred both after positive and after negative antecedents, its frequent occurrence suggests that there is a need for non-ambiguity. Since a second RE can thus reduce the ambiguity of an otherwise ambiguous response, sequential combinations of REs must form part of the candidate space for an optimality-theoretic analysis of response strategies and should receive theoretical attention in future work. The same holds for potentially disambiguating follow-up sentences, which we have not considered here at all. A final aspect concerning ambiguity avoidance is the finding that RE1 occurred with, rather than without a non-manual more often after negative than after positive antecedents (mouthings) and more often in rejections than in affirmations (brow movements). The latter finding is not unexpected insofar as rejections are considered to be marked because disagreeing with an interlocutor is a dispreferred discourse move. Brow movements might be well-suited to signal such markedness because they generally result in the increased prominence of a linguistic structure. This has been shown for brow raises across a number of sign languages (Pfau and Quer, 2010). Also, as we saw in Section 3 for Mandarin, Russian, and Catalan, gestural elements in spoken language response systems may fulfil similar highlighting functions.

References


The prosody of presupposition projection in naturally-occurring utterances

Taylor MAHLER — The Ohio State University
Marie-Catherine de MARNEFFE — The Ohio State University
Catherine LAI — The University of Edinburgh

Abstract. In experimental studies, prosodically-marked pragmatic focus has been found to influence the projection of factive presuppositions of utterances like *these parents didn’t know the kid was gone* (Cummins and Rohde, 2015; Tonhauser, 2016; Djärv and Bacovcin, 2017), supporting question-based analyses of projection (i.a., Abrusán, 2011; Abrusán, 2016; Simons et al., 2017; Beaver et al., 2017). However, no prior work has explored whether this effect extends to naturally-occurring utterances. In a large set of naturally-occurring utterances, we find that prosodically-marked focus influences projection in utterances with factive embedding predicates, but not those with non-factive predicates. We argue that our findings support an account where lexical semantics of the predicate contributes to projection to the extent that they admit QUD alternatives that can be assumed to entail the content of the complement.

Keywords: projective content, attitude predicates, (non-)factive predicates, prosody.

1. Introduction

Understanding what speakers mean requires listeners to determine which propositions conveyed by the speakers’ utterance are intended as speaker commitments. In some cases, this task is relatively simple. For example, when a speaker asserts that a proposition is true, they convey their commitment to its truth. A speaker who utters (1) asserts the proposition “*Sinn und Bedeutung* is an excellent conference” and as a result, they commit themselves to its truth.

(1) *Sinn und Bedeutung* is an excellent conference.

But assertion is not the only means by which speakers convey their propositional commitments. In (2), the speaker has not asserted that the content of the complement (henceforth CC) of *know* is true, and yet they seem to be committed to its truth.

(2) John knows that *Sinn und Bedeutung* is an excellent conference.

The observation that the speaker is committed the truth of the CC of *know* is rather unsurprising, given that the CC of *know* is entailed by the (asserted) main clause proposition, and speakers are typically taken to be committed to the entailments of propositions that they assert. But the example in (3) demonstrates that speakers can appear committed to non-entailed propositions:

(3) a. John doesn’t know that *Sinn und Bedeutung (SuB)* is an excellent conference.
b. Does John know that *SuB* is an excellent conference?
c. Perhaps John knows that *SuB* is an excellent conference.
d. If John knows that *SuB* is an excellent conference, he will submit an abstract.

In (3), the complement of *know* is embedded under four different entailment-cancelling operators. While the CC is not entailed by the main clause proposition, the speaker can never-
theless be taken to be committed to the content expressed by the complement. Content that displays such behavior is said to project (e.g., Karttunen, 1971; Heim, 1983; Chierchia and McConnell-Ginet, 1990). The observation that the speaker can be taken to be committed to the CC requires an explanation that does not hinge on entailment. The classical explanation is that the speaker’s commitment to the CC arises from another property of the CC: that it is presupposed. According to standard accounts, the presupposition of the CC arises due to the speaker’s use of know, which is assumed to lexically encode its complement as a presupposition (e.g., Heim, 1983; van der Sandt, 1992). Such predicates, called factives, have been distinguished from non-factive clause-embedding predicates like think and believe which are not assumed to lexically-encode their complements as presuppositions (Kiparsky and Kiparsky, 1970).

However, the CCs of factive predicates do not always project. As Beaver (2010) pointed out based on examples like (4), projection (in English) is sensitive to prosodically-marked focus. When a constituent within the complement receives narrow focus, as plagiarized in (4a), the CC (that the work is plagiarized) seems not to project. However, in the absence of narrow focus within the complement as in (4b), the CC seems to project (capitals indicate narrow focus):

(4) a. If the T.A. discovers that your work is **PLAGIARIZED**, I will be forced to notify the dean.
   b. If the T.A. **DISCOVERS** that your work is plagiarized, I will be forced to notify the dean.

These observations are predicted by accounts that assume that presupposition projection arises from the set of alternatives evoked by the focal structure of the utterance (e.g., Abrusán, 2011; Abrusán, 2016; Simons et al., 2017; Beaver et al., 2017). Following Rooth (1992), these accounts assume that the interpretation of focus contributes a set of alternative propositions. For example, the interpretation of focus in (4a) introduces the alternatives in (5a), whereas the interpretation of focus in (4b) introduces the alternatives in (5b):

(5) a. \{q: Your work is P | P is a property\}
   b. \{q: The T.A. R that your work is plagiarized | R is a cognitive attitude\}

On most theories of questions, the semantic value of a question is the set of propositions that are possible answers to it (e.g., Karttunen, 1971; Rooth, 1992). Hence, questions and focal alternatives are semantically equivalent. An important related observation is that the focus-marking of an utterance must be congruent with the question it addresses (e.g., Roberts, 2012). For instance, an utterance with the focus marking in (4a) would be a felicitous response to a question about the status of the student’s work, e.g., *What property does your work have?* This question is equivalent to the set of alternatives in (5a). But such an utterance would be an infelicitous response to a question about the T.A.’s attitude with respect to the complement proposition, e.g., *What cognitive attitude does the T.A. have to the proposition that your work is plagiarized?* This question is equivalent to the set of alternatives in (5b). On the other hand, an utterance with the focus marking in (4b) would be a felicitous response to the question represented in (5b), but not to the question represented in (5a).

Beaver et al. (2017) formalize the relation between focus, questions, and CC projection in sentences with factive predicates in terms of Roberts’ (2012) notion of the Question Under Discussion (QUD). On their account, the focal structure of the utterance provides a set of alter-
native propositions, as outlined above, and a contextually-restricted subset of these alternatives corresponds to the QUD. In other words, focus-marking does not fully determine the set of propositional alternatives: in the context of the utterance, some alternatives will be ruled out. For example, the alternative set in (5a) introduced by the focus-marking in (4a) presumably does not include the alternative The T.A. discovers that your work is publishable, as there would be no reason that the professor would be “forced to notify the dean” were this alternative to be true. The QUD for (4a) is not simply (5a), but rather the set of propositions that are actually under consideration, that is propositions in which \( P \) is instantiated by properties such as e.g., plagiarized, fabricated, unsatisfactory, and other properties that would warrant a report to the dean. Beaver et al. (2017) hypothesize that CC projection is predicted by the CC’s relation to the QUD. Specifically, they hypothesize that the CC will project when the QUD alternatives entail the CC, i.e., when each alternative in the QUD entails that the CC is true. Such content is characterized as “not-at-issue”, while content that is not entailed by the QUD is “at-issue”. This hypothesis is formulated in slightly different terms across publications. We use the version of Tonhauser et al. (2018) who recast the hypothesis as the Gradient Projection Principle (GPP), characterizing projection as a gradient rather than a binary property of content:

\[ \text{(6) Gradient Projection Principle (GPP): If content } C \text{ is expressed by a constituent embedded under an entailment-cancelling operator, then } C \text{ projects to the extent that it is not at-issue.} \]

In utterances with clausal complements, the GPP predicts that the CC projects less when a constituent within the complement is prosodically focused. For utterances in which complements are embedded under factive predicates, this prediction has been borne out in several experimental studies using laboratory speech (e.g., Cummins and Rohde, 2015; Tonhauser, 2016; Djärv and Bacovcin, 2017). Though work on QUD-based approaches to CC projection primarily investigates projection in utterances with factive predicates, Djärv and Bacovcin (2017) also explored prosodically-marked focus and projection in utterances with non-factive predicates. Surprisingly, they found that the CCs of non-factives actually project more when a complement constituent is prosodically focused. In addition, they found that the influence of prosodically-marked focus on the projection of both factive and non-factive CCs was small relative to the influence of factivity. Based on these findings, they argue that projection is constrained by the lexical semantics of clause-embedding predicates, with factives contributing inferences that can conflict with inferences based on the prosodically-marked QUD.

Given the minimal research on focus and non-factive CC projection as well as Djärv and Bacovcin’s (2017) suggestive findings that focus interacts differently with factives and non-factives, it remains an open question how the lexical semantics of clause-embedding predicates interact with prosodically-evoked QUDs to influence projection. We shed light on this question by investigating projection in naturally-occurring utterances with both factive and non-factive predicates. Consistent with prior experimental work on laboratory speech and the predictions of the GPP, we find that factive CCs project more when the prosodically prominent constituent is within the matrix clause compared to the complement. However, for utterances with non-factive predicates, prosodically-marked focus did not influence projection.

We outline a preliminary analysis to account for our findings. We start from the assumption that there are two relevant strategies for backgrounding information: expressing the content as
the complement of a clause-embedding predicate, and using prosodically-marked information structure. However, content that is backgrounded by either of these strategies does not automatically become not-at-issue. We suggest that whether the CC is not-at-issue and potentially projective depends on the interaction between the lexical semantics of the embedding predicate used to background the CC together with information-structural backgrounding. The CCs of factives predicates are (by default) associated with a QUD in which each alternative proposition, including the CC itself, is true. However, the existing conversational background and the information structure of the utterance (via accenting of the complement) can introduce potentially false propositions into the QUD, thereby making the CC at-issue. Otherwise, the QUD alternatives under consideration are all true, and so the CC is not-at-issue. On the other hand, when the embedding predicate is non-factive, the associated QUD obligatory contains at least one alternative in which the CC is false. Even when the CC is backgrounded by virtue of deaccenting the complement, it remains at-issue. The lexical semantics of the embedding predicate contributes to the perception of projection to the extent that they admit QUD alternatives that can be assumed to entail the CC. We sketch the details of this account in section 5.

2. Experimental investigations of prosody and projection with laboratory speech

To the best of our knowledge, prior comprehension experiments investigating prosodically-marked focus and CC projection have exclusively used laboratory speech. The stimuli were recorded by the experimenters, and their prosodic properties were manipulated either by the speaker of the utterance or by manipulating the recordings. Across these experiments, participants listened to the manipulated utterances and indicated the extent to which the CC projects using rating tasks that differed slightly. The stimuli in these experiments varied slightly too, but all used a third person subject for the matrix verb. Cummins and Rohde (2015) explored projective content associated with a variety of standard presupposition triggers, restricting their investigation of CC projection to the CCs of factive predicates within the scope of negation. Tonhauser’s (2016) stimuli were utterances with factive predicates embedded within the scope of the epistemic modal perhaps. Djärv and Bacovcin (2017) used stimuli with both factive and non-factive predicates under the epistemic modal might. In this section, we review these three studies with the goal of highlighting the extent to which their findings are predicted by the GPP.

2.1. Cummins & Rohde 2015

Cummins and Rohde (2015) investigated contents associated with standard presupposition triggers, including factive predicates. Negation was used as the entailment-cancelling operator for all target sentences, as illustrated in the target sentence in (7).

(7) Bill doesn’t regret arguing with his boss.

Participants heard utterances of sentences like (7) in either a “focus condition” in which the final word of the sentence carried a pitch accent (Bill doesn’t regret arguing with his BOSS), or a “neutral condition” (no details are provided about the prosodic properties of the neutral condition). The focus condition evokes a QUD roughly equivalent to With whom does Bill regret arguing? As this QUD does not entail the CC of regret, i.e., Bill argued with his boss, the CC is considered at-issue and the GPP therefore predicts that it should not project. In contrast, the QUD associated with the neutral condition (though not specifically identified in their paper) concerns the truth of the main clause proposition: Does Bill regret arguing with
his boss? As this QUD does not entail the CC, the CC is considered to be not-at-issue and predicted by the GPP to project.

After listening to a target sentence, participants responded to a question about the likelihood of the CC, on a 7-point Likert scale from 1/“unlikely” to 7/“likely.” For (7), the question was How likely is it that Bill argued with his boss? Higher responses on the scale were taken to indicate that the CC was more likely to project. Participants provided higher ratings in the neutral condition than in the focus condition, suggesting that whether content addresses the prosodically-evoked QUD influences projection. Thus, these findings are consistent with the GPP. However, it is worth noting that the decrease in projectivity in the focus condition varied greatly depending on which presupposition trigger was used. In fact, in some cases, the rating in the focus condition was higher than that of the neutral condition (i.e., forget, manage, stop, return). Moreover, as the authors note, this study did not control for specific prosodic properties of the utterances: the speaker recording the target sentences attempted to communicate a particular meaning, not produce a particular prosodic contour. In particular, no details are provided about the prosodic properties of the neutral condition. Although we can assume this condition lacks narrow focus in the complement, it is not clear whether other prosodic effects could be playing a role here, e.g., the level of prominence on the matrix verb. This leaves open several questions about the role of prosody in these findings.

2.2. Tonhauser 2016

Building on Cummins and Rohde’s (2015) findings, Tonhauser (2016) conducted several experiments in which the specific prosodic properties of the stimuli were carefully controlled. A native English speaker trained in the Tones and Break Indices (ToBI) annotation system (Beckman and Ayers, 1997) recorded the utterances. The target sentences were produced in three different prosodic conditions, one with a H* pitch accent on the predicate, one with a L+H* pitch accent on the final content word of the complement, and one with a L+H* pitch accent on the subject pronoun of the complement. The investigation was constrained to the CC of cognitive factive predicates under the epistemic modal perhaps as in (8).

(8) a. Perhaps he DISCOVERED that she’s a widow. (H*-on-predicate)
   b. Perhaps he discovered that she’s a WIDOW. (L+H*-on-content)
   c. Perhaps he discovered that SHE’S a widow. (L+H*-on-pronoun)

Participants listened to an utterance and answered a question about the speaker’s certainty with respect to the CC on a 7-point Likert scale from 1/“No, not certain” to 7/“Yes, certain”. For example, for (8), participants were told that the speaker, Dana, was speaking about two individuals named Scott and Valeria, and was then asked Is Dana certain that Valeria is a widow?

Consistent with Cummins and Rohde’s (2015) findings, participants provided lower ratings to complement accented compared to matrix accented utterances. Tonhauser (2016) interprets this finding as support for QUD-based accounts of projection. In the L+H*-on-content and L+H*-on-pronoun conditions, the CC addresses the QUD prosodically-evoked by the utterance and hence is at-issue. For example, in the L+H*-on-pronoun condition (8c), the CC addresses the induced QUD Who did Scott discover is a widow? In contrast, the QUD evoked by the H*-on-predicate condition (8c) is (assumed to be) about the matrix subject’s attitude with respect to the CC, e.g., What’s the Scott’s cognitive attitude with respect to the proposition that Valeria
is a widow? The proposition *Valeria is a widow* does not address this QUD, and is hence not-at-issue. In sum, these results are consistent with the predictions of the GPP: the CC is more likely to project when it is not-at-issue (the H*-on-predicate condition) compared to when it is at-issue (the L+H*-on-content and L+H*-on-pronoun conditions).

A further experiment reported in Tonhauser (2016) investigated whether different pitch accents influence the projection of the CC. Pitch accents were placed on both the predicate and the final content word in each condition. More specifically, this experiment looked at the two conditions shown in (9), where the (L+)H* pitch accent is considered more prominent than H*. The experimental procedure was identical to the single pitch accent experiments.

(9)  a. Perhaps he DISCOVERED that she’s a WIDOW.  
     \hspace{1cm} H*  
     \hspace{2cm} \hspace{2cm} \hspace{2cm} \hspace{1cm} (L+)H*  

   b. Perhaps he DISCOVERED that she’s a WIDOW.  
     \hspace{1cm} (L+)H*  
     \hspace{1cm} \hspace{1cm} \hspace{2cm} \hspace{1cm} \hspace{2cm} \hspace{1cm} \hspace{1cm} \hspace{1cm} \hspace{1cm} H

Tonhauser (2016) reports that participants rated the speaker as less certain about the CC when the pitch accent on the last content word was more prominent (9a), compared to the opposite case in (9b). In light of the complexity of the prosodic contours of these stimuli, Tonhauser (2016) points out that they might be consistent with more than one information-structural analysis. She analyzes the more prosodically prominent constituent as corresponding to the focus of the utterance. Thus, the focus of (9a) is the complement verb phrase *is a widow*, while the predicate *discover* is the focus of (9b). Hence, the QUD associated with (9b) is analyzed in the same way as for (8a): the QUD evokes alternatives about the subject’s attitude toward the complement proposition. Since the CC is entailed by this QUD, it is not-at-issue. In contrast, the QUD associated with (9a) is about properties of Valeria, e.g., *What property did Scott discover about Valeria?* The CC addresses this QUD, and is therefore at-issue.

Again, as predicted by the GPP, these results indicate that the CC is more likely to project when it is not-at-issue as signalled by focus ((L+)H*) on the matrix predicate (9b) compared to when it is at-issue as signalled by focus ((L+H*) in the complement (9a). Moreover, these findings suggest that listeners attend to information structure as signalled by relative prominence. Interestingly, Tonhauser (2016) notes that the secondary prominences in (9) partially fit the description of a contrastive topic (Büring, 2003), but argues that this is an unlikely interpretation for this data as both pitch accents are contained in a single intonational phrase. However, it is not clear that this is enough to rule out a contrastive interpretation (cf. Calhoun, 2010). In any case, we would still expect contrastive topic/focus configurations to be possible on these types of sentences. Assuming that contrastive topics generate alternatives in a similar way to foci, this could greatly impact the QUD and hence what projects for utterances collected in the wild.

2.3. Džarv & Bacovcin 2017

Whereas Cummins and Rohde’s (2015) and Tonhauser’s (2016) investigation of CC projection was limited to the CCs of factive predicates, Džarv and Bacovcin (2017) also investigated the influence of prosody on CC projection in utterances with non-factive predicates. As illustrated in (10), the epistemic modal *might* was used as the entailment-cancelling operator.

(10) John might’ve discovered/believed that Anna left town.
For target sentences with embedding predicates, the subject of the complement was focused in one condition (11a), and the predicate was focused in the other condition (11b). For the unembedded target sentences, the matrix subject was focused in one condition (11c). It is not clear from the description of the unembedded stimuli whether and which constituent was focused for the other condition, but presumably none were narrowly focused (11d).

(11)  
   a. John might’ve discovered that ANNA left town.  
   b. John might’ve DISCOVERED that Anna left town.  
   c. ANNA left town.  
   d. Anna left town.

The rating task was identical to the one in Tonhauser’s (2016) study. For utterances with factive predicates, participants’ ratings followed the pattern of results from Cummins and Rohde’s (2015) and Tonhauser’s (2016) experiments: participants provided higher certainty ratings when the predicate was focused than when a constituent within the complement was focused. However, for a subset of utterances with (verbal) non-factive predicates, the effect of focus was actually reversed: participants provided higher certainty ratings when a constituent within the complement was focused compared to when the predicate was focused. Djärv and Bacovcin (2017) also found that participants’ ratings were influenced by the factivity of the predicate: the CCs of factive predicates were associated with higher ratings than the CCs of non-factive predicates. Crucial to their analysis is their observation that the effect of factivity was substantially greater than the effect of focus. They interpret this result as evidence against “strong versions of pragmatic accounts of projection” and specifically “the claim that such causal pragmatic effects are driven by prosodic signals of the QUD” (p.128).

This leads them to argue for an account of projective meaning in terms of interacting lexical constraints and prosodically-signalled pragmatic information about the QUD. They assume that factive predicates encode their complements as presuppositions, giving rise to the inference that the CC is in the common ground. For example, the use of discover in (12) is associated with the “factive” inference in (12a) that Anna left town is in the common ground. Additional inferences are derived from the QUD indicated by the prosody of the utterance. When the complement subject is focused as in (12a), the QUD is about the identity of the person who left town, i.e., (12c). This QUD generates the two additional inferences (i) that it is common ground that someone left town, and (ii) that the identity of this individual is not common ground.

(12) John might’ve discovered/believed that ANNA left town.
    a. inference from factive discover: That Anna left town is common ground.
    b. inference from non-factive believe: nothing.
    c. inferences from QUD ‘Who left town?’:
       (i) That someone left town is common ground.
       (ii) That the identity of the person who left town is not common ground.

The latter of these two inferences, i.e., (12c-ii), conflicts with the factive inference (12a) from discover. But no conflict with QUD inferences arises with non-factive predicates like believe, since such predicates do not give rise to an inference about whether the CC is in the common ground. The QUD-based inferences associated with focus on the predicate also do not conflict with the factive inferences. With focus on the predicate as in (13), the QUD is about the matrix subject’s attitude toward the CC, i.e., (13c). This QUD is irrelevant to whether the CC is
common ground, so its associated inference (13c-i) does not conflict with the factive inference.

(13) John might’ve DISCOVERED/BELIEVED that Anna left town.
   a. inference from factive discover: That Anna left town is common ground.
   b. inference from non-factive believe: nothing.
   c. from QUD ‘What cognitive attitude does John have (or might have) to the proposition that Anna left town?’:
      i. John has some cognitive attitude to the proposition that Anna left town.

Djärv and Bacovcin (2017) suggest that the results of their experiment reflect how the participants’ synthesized these various inferences. The increased ratings for utterances with factives compared to non-factives, regardless of prosodic realization, suggest that the factive inference carries more weight than inferences based on prosodically-evoked QUDs. When the QUD is irrelevant to the CC, as when the predicate is focused, participants only attend to the factivity of the predicate in evaluating the speaker’s commitment to the CC. When one of the QUD-based inferences in (ii) conflicts with the factive inference, participants reduce their rating to reflect diminished confidence that the factive inference holds.

For the utterances with non-factives, Djärv and Bacovcin (2017) argue that the increased ratings associated with complement subject focus are due to the QUD-based inference in (12c-i). They suggest that the inference that someone left town makes the CC more probable. Once it is known that someone left town, it becomes more probable that Anna left town, and this higher probability is reflected in increased certainty ratings. In contrast, the inferences associated with matrix focus are completely independent of whether the CC is true and so they do not affect participants’ certainty ratings. However, Djärv and Bacovcin (2017) do not specifically test whether this existential inference (12c-i) associated with the complement subject is actually available to listeners, and whether this can affect the probability of a particular alternative being true separate from other factors. It could be that the a priori probability that Anna left town is extremely low because, for example, it is known that she is cursed to die if she does, or simply that the listener believes the subject (John in (12)) to be unreliable.

In sum, the results of these experimental studies provide evidence for QUD-based analyses of CC projection, at least when the complement is embedded by a factive predicate. However, outside of impressionistic observations (e.g., Beaver, 2010; Simons et al., 2017), the relation between prosody and factive presupposition projection has not been investigated in naturally-occurring discourse. In the following, we extend the evidence base for this relation by collecting annotations of naturally-occurring utterances with clausal complements that target speaker intuitions about projection and focus.

3. Data

The discourses selected for annotation come from the CommitmentBank (de Marneffe et al., 2019), which contains 1,200 discourses from 3 corpora: the British National Corpus, the Wall Street Journal, and the Switchboard Corpus of spontaneous telephone dialogues. As illustrated in (14), each discourse contains a target sentence featuring a clause-embedding predicate and a clausal complement, embedded under an entailment-cancelling operator (negation, modal, antecedent of conditional, or question), preceded by up to two context sentences. Of the 464 Switchboard discourses in CommitmentBank, we extracted the audio files corresponding to
392 discourses. Each discourse was annotated for projection, and the target sentences from 350 discourses were annotated for prominence in a separate annotation task. We restrict our analysis to the 350 discourses that were annotated for both projection and prominence.\(^2\)

(14) A: I work in the airline, marketing group.
B: Oh.
A: So, we do a lot of,
B: I didn’t even know they had anything like that. (SWBD-270)

3.1. Projection annotations
To determine whether interpreters judge the speaker of the utterance to be committed to the CC, we asked participants to listen to the discourses and rate how certain the speaker is that the CC is true. For each discourse segment, judgments were elicited from at least eight self-reported native English speakers, using a questionnaire on Amazon’s Mechanical Turk Platform.\(^3\) The 392 discourse segments were distributed in groups of 8 across 49 questionnaires. As illustrated in the sample trial in Figure 1, participants were instructed to listen to the discourse segment and answer two questions. For the first question, the completion question, they were presented with an elided version of the target sentence that they had just listened to. They were then asked to indicate which of two minimally different utterances the speaker had actually produced: one utterance corresponded to the utterance on the recording, and one was subtly different from what the speaker had said. For example, the speaker in Figure 1 had actually said “I didn’t even know they had anything like that”, so the second of the two utterances was the correct option. The incorrect utterances were constructed in such a way that they were compatible with the elided version of the target sentence, i.e., participants could not tell which was the correct or incorrect utterance from looking at the elided sentence. Incorrect responses to this question were taken to indicate that the participant had not listened to the entire audio clip or not paid attention.

\[\text{Listen to the whole snippet:} \quad \text{0:00 / 0:06} \quad \text{Play} \quad \ldots\]

Victoria just said: "I didn't... had anything like that."
What did Victoria actually say? (You are allowed to listen again.)

- [ ] "I didn't know the airline had anything like that."
- [x] "I didn’t even know they had anything like that."

Now given what Victoria said, tell us how certain Victoria is that the airline had anything like that.

- [ ] Victoria is certain that it is true
- [ ] Victoria is certain whether it is true or false
- [ ] Victoria is not certain whether it is true or false
- [ ] Victoria is certain that it is false

Figure 1: Sample trial in the projection annotation task.

\(^2\)The data and annotations are available at https://github.com/mcdm/CommitmentBank-Prosody.
\(^3\)The elicitation was performed with IRB approval; distribution was restricted to IP addresses in the United States. Annotators were paid $1.50 for completing the questionnaire.
The second question probed participants’ intuition with respect to the projection of the CC: participants were asked to indicate how certain the speaker is with respect to the CC, given what had been said. Participants responded on a 7-point Likert scale labeled at three points 3/“[The speaker] is certain that it is true, 0/“[The speaker] is not certain whether it is true or false”, -3/“[The speaker] is certain that it is false.

In addition to the 8 discourse segments from the CommitmentBank, each questionnaire included 2 constructed “filler” discourse segments to ensure that participants were paying attention. For half of the fillers, participants were expected to rate the speaker as highly certain about the truth of the content in question, as in (15a); for the other half, participants were expected to rate the speaker as highly certain that the content was false, as in (15b).

(15)  
  a. Megan: “so I love, you know, baseball teams. In fact, Nolan Ryan was on the news tonight.”
     Now given what Megan said, tell us how certain Megan is that Nolan Ryan was on the news tonight.
  
  b. Judy: “But even after spending so much time studying, Olivia didn’t manage to pass the test.”
     Now given what Judy said, tell us how certain Judy is that Olivia passed the test.

The annotation task was completed by 288 unique participants (some participants completed multiple questionnaires). We removed data from participants who responded incorrectly to one or both fillers or ≥2 completion questions (N=132) and participants who did not report American English as their native language (N=2). The final dataset included annotations from 154 unique participants.

3.2. Prominence annotations

Prominence annotations were collected using the Rapid Prosody Transcription methodology (RPT; e.g., Cole et al. 2017), presented via the Language Markup and Experiment Design software (LMEDS; Mahrt 2018). RPT was performed for the target sentences of 350 discourses that were annotated in the projection annotation task. Participants listened to the utterance of the target sentence, saw its corresponding transcript, and were instructed to select the word that they heard as most prominent. For each utterance, we elicited such judgments from at least six self-reported native English speakers using a questionnaire linked from Amazon’s Mechanical Turk Platform. The 350 utterances were distributed in groups of 14 across 25 questionnaires. As illustrated in the sample trial in Figure 2, participants were instructed to listen to the audio recording and click on the word in the transcript that they heard as most prominent. The questionnaire did not allow participants to advance without both listening to the recording and selecting a word.

In addition to the 14 target sentence utterances, two constructed “filler” utterances were included within each questionnaire to ensure that all participants were paying attention. In each filler utterance, one word was produced with an exaggerated pitch accent. Participants were

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4The 42 discourses used in the projection annotation task but not RPT were ones in which the transcript and audio recording differed substantially from each other.

5The annotations were performed with IRB approval; distribution was restricted to IP addresses in the United States. Annotators were paid $0.85 for completing the questionnaire.
expected to select this word as the most prominent. The annotation task was completed by 190 unique participants (some participants completed multiple questionnaires). We excluded data from participants who responded incorrectly to one or both fillers (N=36) or did not report American English as their native language (N=5). The final dataset included annotations from 162 unique participants.

The annotations were classified into three categories. Items for which more than 65% of participants identified the prominent word in the matrix clause were labeled “matrix”. Items for which more than 70% of participants identified the prominent word in the complement clause were labeled “complement”.\(^6\) Items that met neither of these criteria were labeled as having “broad” focus, i.e., the entire sentence was assumed to be in focus. The distribution of labels by the factivity of the embedding predicate is shown in Table 1.\(^7\) Examples of the three categories are given in (16)-(18), with the percentage of annotators who selected each word indicated below it (words that were not selected by any annotators are left blank). The information in parentheses following each item includes the item ID in the CommitmentBank, the total number of annotators for that item in the prominence annotation task, and the mean speaker certainty rating from the projection annotation task.

<table>
<thead>
<tr>
<th></th>
<th>Matrix</th>
<th>Complement</th>
<th>Broad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factive</td>
<td>12</td>
<td>50</td>
<td>18</td>
<td>80</td>
</tr>
<tr>
<td>Non-factive</td>
<td>27</td>
<td>181</td>
<td>62</td>
<td>270</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>231</td>
<td>80</td>
<td>350</td>
</tr>
</tbody>
</table>

Table 1: Distribution of prominence annotations by predicate factivity.

\(^6\)We increased the threshold for labeling an item “complement” relative to the “matrix” threshold because the complement clause is almost always longer than the matrix clause.

\(^7\)The factive predicates were see, find, know, realize, bother, recognize, understand and notice. The non-factive predicates were believe, bet, convince, feel, foresee, guarantee, guess, hear, hypothesize, imagine, mean, occur, say, seem, swear, take, tell and think.
Prior research on projection of CCs has mostly been restricted to utterances in which either the complement or the matrix clause has a single narrowly focused constituent. However, the prominence annotations suggest that these sorts of utterances are relatively infrequent. In our data, annotators rarely identified the same word as prominent: for only 26% (92) of the utterances more than 70% of the annotators agreed on the prominent word. Moreover, 23% of the utterances were categorized as exhibiting “broad” focus.

4. Results

Participants’ mean certainty ratings by predicate factivity and collapsed prominence category are shown in Figure 3. The data were modeled using a mixed-effects linear regression predicting participants’ certainty ratings from predicate factivity (factive vs. non-factive), focus (matrix vs. complement vs. broad), and their interaction. The random effects structure included by-participant and by-item random intercepts. A log-likelihood comparison between this model and a model without the interaction fixed effect between focus location and predicate factivity revealed that the interaction was significant ($\chi^2(2) = 8.66, p < 0.02$), such that focus only had an effect on the CCs of factive predicates. The CCs of factive predicates were less projective with complement focus than with matrix focus ($\beta = -1.52, SE = .46, t = -3.28$), and those with complement focus were less projective than those with broad focus ($\beta = -.83, SE = .39, t = -2.11$). Factive CCs with broad focus and factive CCs with matrix focus were equally projective ($\beta = -0.68, SE = .53, t = -1.27$).

For the purposes of evaluating the predictions of QUD-based accounts of projection and to compare with prior experimental research on laboratory speech, we restrict our discussion to the items in the categories of “matrix” and “complement”. However, we note that a full picture of the relation between prosody and projection behavior of CCs will involve investigating these other sorts of prosodic patterns, in particular distinguishing between cases in which a single constituent is prominent vs. multiple constituents within a clause as well as instances in which the entire utterance is focused, i.e., our “broad” focus cases.
Figure 3: Mean speaker certainty ratings by predicate factivity and focus (with 95% confidence intervals). The y-axis values correspond to the 7-point Likert scale labeled at 3/“The speaker is certain that it is true”, 0/“The speaker is not certain whether it is true or false”, and -3/“The speaker is certain that it is false”.

5. Discussion
Our two main findings are (i) that the CCs of factive predicates are less projective when a complement constituent is focused compared to when a matrix constituent is focused, and (ii) prosodically-marked focus does not influence the projection of non-factive CCs. In this section, we discuss the extent to which these findings are consistent with prior findings on laboratory speech. We then outline a preliminary analysis of our findings that reframes insights from QUD-based accounts of projection to capture the behavior of non-factive CCs.

For factive CC projection, our findings are consistent with those from prior laboratory speech studies, confirming that speakers and hearers do attend to information structure in drawing factive inferences: factive CCs are more projective when the matrix is focused compared to when the complement is focused. This finding is predicted by existing QUD-based analyses of factive presupposition projection (Beaver et al., 2017; Simons et al., 2017).

Our findings for non-factives, however, are not consistent with findings from the single lab-speech based experiment that included non-factive CCs. As in Djärv and Bacovcin (2017), we found that prosodically-marked information structure affects non-factive CC and factive CC projection differently. However, whereas Djärv and Bacovcin (2017) found that non-factive CCs were more projective with complement than matrix focus, we found that information structure had no effect on non-factive CC projection. One difference between our data and the stimuli used in Djärv and Bacovcin (2017) that might account for this difference in findings relates to the person of the matrix subject. Whereas Djärv and Bacovcin’s (2017) stimuli were restricted to sentences with third person matrix subjects, our data included sentences with first and second person matrix subjects as well.

Another difference between Djärv and Bacovcin’s (2017) study and ours has to do with the location of the focused constituent. Whereas the subject of the complement was focused in all
their complement-focus stimuli, utterances in our dataset were much more diverse: in some cases, the complement subject was focused as in (19a) and (27b), but other constituents were often focused as well as in (19b), and there were also cases in which multiple constituents were focused as in (19c). Each of the non-factive complement focus cases in (19) received negative mean certainty ratings, indicating that the CC did not project in these cases.

(19) a. I really did not feel that I would buy a Dodge 88.9 11.1 (SWBD-221, N=9, μ = -2.44)
b. I can’t say I really enjoyed it all that much 85.7 14.3 (SWBD-046, N=7, μ = -2.80)
c. I don’t think the teachers could stand the stress all year long frankly 44.4 44.4 11.1 (SWBD-298, N=9, μ = -0.50)

As discussed in detail in section 2.3, Djärv and Bacovcin (2017) account for their finding that prosody influences projection in terms of potentially conflicting inferences between the lexical semantics of the embedding verb and the prosodically-evoked QUD. We propose an alternative analysis to account for the differing projection behavior of factive and non-factive CCs with respect to prosodically-marked focus. Our analysis starts from the observation that there is more than one way to background information in a discourse. On the one hand, speakers can signal that information is in the conversational background by acting as if it is already in the common ground. This is Stalnaker’s (1974) notion of “speaker presupposition”. On the other hand, speakers can signal that information is backgrounded in the sense that it is not currently being updated at that moment in the discourse; rather, that content remains constant with respect to the current state of the common ground. This is the type of backgrounding accomplished by information structure (Vallduví, 1993). However, in information structure frameworks such as Vallduví (1993), backgrounding does not always indicate that backgrounded content is an accepted part of the common ground. This distinction between information structural backgrounding and common ground status is further supported by Djärv and Bacovcin’s (2017) finding that non-factive CCs are more projective when the complement is backgrounded.

The observation that factive predicates often, but not always, lead to the inference that the CC is in the common ground can be accounted for following a QUD-based analysis such as that outlined by Beaver et al. (2017). That work claims that in an out-of-the-blue, overhearing context of an utterance with a factive predicate, listeners infer a QUD in which each alternative proposition is true, i.e., in which the alternatives are veridical. For example, in an out-of-the-blue situation, the utterance in (20a) (cf. Djärv and Bacovcin, 2017) generates the alternatives in (20b). However, a listener who overhears (20a) is unlikely to take the QUD to include all possible propositions. Rather, a reasonable way to restrict to the alternatives in (20b) is to assume that they only include propositions that are potentially discoverable, i.e., those propositions that are true. In other words, the listener can reasonably infer that the QUD is (20c). This QUD entails that p is true, so Anna left town is not-at-issue, and backgrounded in the common ground sense.

(20) a. John might have discovered that Anna left town.
b. \{ q: John discovered p \}
c. \{ q: John discovered p \mid p \text{ is true} \}
In contrast, the use of a non-factive predicate like believe does not generally lead to an inference that the CC is in the common ground, because, as Beaver et al. (2017) point out, such predicates are non-veridical. The semantics of believe alone do not allow the listener to restrict the alternatives in (21b) to those in which \( p \) is true: \( p \) need not be true for John to believe that it is. Unless the listener has some external reason to do so (e.g., \( p \) has high prior probability, or the context suggests that the speaker is committed to its truth), \( p \) is unlikely to be taken as common ground.

(21)  
  a. John might have believed that Anna left town.  
  b. \{\( q: \) John believed \( p \)\}

Focus on the matrix verb in (20a) and (21a) evokes the alternatives in (22):

(22) \{\( q: \) John \( R \) that Anna left town | \( R \) is a cognitive attitude\}

Whether the QUD constructed from the alternatives in (22) entails \( p \), i.e., that Anna left town, depends on the set of attitudes that instantiate \( R \). If they are all veridical, then the QUD will entail \( p \), and \( p \) will project. However, if at least one alternative involves a non-veridical attitude, the QUD will not entail \( p \), and the CC will not project. While the precise identity of the alternatives is context-dependent, the semantics of non-factive predicates obligatorily introduce this non-veridicality into the alternative set, yielding the QUD in (23).\(^8\) For example, the QUD evoked by (21a) with focus on believe inevitably includes the alternative John believes Anna left town, which does not entail that Anna left town. The fact that a non-factive verb like believe was used in the first place produces a scalar implicature that stronger veridical attitudes like know could not have been felicitously used. That is, it must be possible that the CC is false, otherwise the stronger predicate would have been used. So, even though the CC is information-structurally backgrounded by the prosodic realization of the utterance, it will still be considered at-issue, and hence will not project.

(23) \{\( q: \) John \( R \) that Anna left town | \( R \) is a cognitive attitude and there is at least 1 non-veridical \( R \)\}

For factive embedding verbs, there is no such expectation that the QUD contains an alternative with a non-veridical attitude. When (20a) is uttered with focus on the embedding verb, the alternative set (22) cannot be constrained to a QUD in which there are non-veridical attitudes among the alternative propositions. Rather, the listener is likely to infer the QUD in (24):

(24) \{\( q: \) John \( R \) Anna that left town | \( R \) is a cognitive attitude there are 0 or more non-veridical \( R \)\}

However, the discourse context or other speech cues can still provide other evidence to the contrary. For example, speaker A’s utterance in (25) obtains a low projection score (-1.25) as it seems to express some uncertainty towards B’s previous assertion, by asserting that it wasn’t already in A’s beliefs.

(25)  
  B: I think we could have made a different agreement back in the late forties era...  
  A: I didn’t realize that we’d signed some type of deal like that.  
  \( 43.0 \) \( 57.0 \) (SWBD-363, N=7, \( \mu=-1.25 \))

\(^8\)There are non-factive predicates that are considered veridical, such as be right and demonstrate (Anand and Hacquard, 2014). However, the non-factive predicates in our data are exclusively non-veridical.
This analysis extends to complement focus cases for factives and non-factives as follows. When a constituent within the complement clause is focused, the QUD is constructed with the embedding verb fixed in the information structural background. The alternatives evoked with focus on Anna for (20a) and (21a) are shown in (26a) and (26b), respectively. Here, the domain restriction that generates the QUD applies to the individuals who are under consideration as town-leavers. Neither the factive (26a) nor the non-factive (26b) entail the CC Anna left town.

(26)  
\begin{align*}
\text{a. } & \{q: \text{John discovered } x \text{ left town}\} \\
\text{b. } & \{q: \text{John believed } x \text{ left town}\}
\end{align*}

Under this analysis, projection of the CC will vary depending on whether other contextual information indicates that it is actually resolved as a speaker commitment. This variability in projection for individual items is attested in our data. For example, unlike the other non-factive complement focus examples shown in (19), (27a) received a high mean speaker certainty rating (+2.13), as it is reasonable to believe the speaker is committed to their descriptions of their own past. Similarly, (27b) shows a factive with narrow focus on the embedded subject, which obtained a relatively high positive mean rating (+1.85). In this case the speaker was talking about a test she took and the salient alternatives are the facts on the test that she now knows.

(27)  
\begin{align*}
\text{a. } & \text{I can’t believe I was so brazen before } 10.0 & 90.0 & \text{(SWBD-62, N=10, } \mu=2.13) \\
\text{b. } & \text{I didn’t realize that our garbage isn’t being decomposed } 100 & \text{(SWBD-303, N=9, } \mu=1.85)
\end{align*}

Our analysis is similar to Djärv and Bacovcin’s (2017) in the sense that the lexical semantics of the embedding predicates interacts with QUD-based inferences. However, unlike Djärv and Bacovcin (2017) who claim that (the absence of) conflicting inferences from these two sources predict differences in projection for factives and non-factives, we suggest that this difference is due to the extent to which the entailments of the QUD are constrained by the semantics of the embedding predicate. This is supported by our experimental results which show that the effect of prosodic variation is much stronger on factives than non-factives. At the very least it supports the case that factive presuppositions are very easily overridden and hence are like the soft presupposition triggers described in Abusch (2010), rather than hard lexical triggers. Moreover, a lexical trigger based analysis alone does not explain our results for the non-factives: we did not see significant differences in projection ratings based on focus placement conditions, but we do see variation in projection for individual items, e.g., (19a) and (27a).

However, these results can be explained by the fact that, for non-factives, information-structural backgrounding does not constrain the QUD alternatives enough to signal that the CC is not-at-issue. Thus, in most cases non-factives do not project. Nevertheless, our study indicates that many factors beyond utterance information structure affect whether the CC is considered at-issue and hence affect perception of speaker certainty, e.g., the a priori probability of the CC given the speaker’s public beliefs and the previous discourse. This can produce projection behavior for non-factives and suppress it for factives. This is in line with Simons et al. (2017) who argue that higher level questions in a discourse structure can affect what is considered at-issue, beyond the immediate prosodically-evoked QUD. Overall, analyzing projection in terms of what is at-issue in a discourse –rather than in terms of conflicts between lexical triggers and
the QUD– allows for a more parsimonious analysis of both factives and non-factives.

6. Conclusion

Prior comprehension experiments on prosodically-marked focus and CC projection have exclusively employed carefully manipulated laboratory speech. Our research using naturally-occurring utterances provides crucial evidence about the extent to which previous observed effects of prosodically-marked focus on CC projection extend to the communication of projective meaning in spontaneous speech. Consistent with what has been found for utterances with factive predicates, we found that the CCs of factive predicates are sensitive to prosodically-marked focus: the CC is less likely to project when the complement receives narrow focus compared to when the matrix clause receives narrow focus. However, for utterances with non-factives, prosody was not found to influence the projection of the CC. We proposed an analysis of these findings along the lines of Beaver et al. (2017), emphasizing that speakers can back-ground information by acting as if it is already in the common ground, or by signaling via information-structure that it is not currently being updated. For utterances with factive predicates, information-structural backgrounding can constrain the QUD alternatives such that the CC is not-at-issue, leading to a projection interpretation. However, non-factive predicates do not easily allow the QUD to be restricted to true alternative propositions; thus, the CC remains at-issue regardless of information-structure, leading to a non-projecting interpretation in the absence of evidence to the contrary.

To provide more rigorous empirical support for this analysis, future work will look more specifically at the types of alternative sets people construct when doing projection ratings. We would also like to know what sort of entailments are accessible from different factive/non-factive driven QUDs. For example, are existential presuppositions actually inferable from complements with subject focus? Beyond this, our findings suggest that future work ought to investigate how other prosodic patterns relate to projection. This study only looked at the location of the most prosodically prominent word in an utterance. We need to better understand how utterances with multiple prosodic prominences are interpreted in terms of information structure, and how this relates to our ‘broad focus’ data and contrastive topic constructions. Full prominence annotation of our data using the RPT method may help shed light on this.

References


9Vaikšnoraitė et al. (2019) have taken a promising first step in this direction by eliciting productions of constructed factive sentences in contexts that bias either projecting or non-projecting interpretations.


Intransitive Causatives in English: Productivity Regularities and Asymmetries

Eugenia MANGIALAVORI RASIA — National Scientific and Technical Research Council – CONICET
Josep AUSENSI — Universitat Pompeu Fabra

Abstract. We analyze a construction generally overlooked in the literature, with key implications for argument structure alternations and VP-internal configuration. This construction involves an object-less causative variant of change-of-state verbs (viz. Intransitive Causative). Unlike better-known monadic (inchoative/unaccusative) alternates, this construction selects for an external argument, an inanimate entity, interpreted by default as probable cause of a change of state. Here, intransitivity correlates with noneventivity. Data suggest that this construction renders an Individual-Level Predication—basically, a subject bearing the potential to eventually trigger an associated change of state as defining property. Based on the pure stative behavior of such a construction (clearly seen in Romance and Greek, cf. Mangialavori Rasia, to appear), we show that eventivity is structurally achieved, and that stative instances of these verbs are possible in various languages (Alexiadou and Iordăchioaia, 2014; Mangialavori Rasia, 2018). Such data argue against the prevalent view that verbs undergoing causative alternation involve change of state or eventive denotation as core part of their lexical meaning and that causative interpretation is a byproduct of transitivity (Hale and Keyser, 2002). In the present paper, we shift the empirical focus to English and note that English shows a productive regularity that deserves to be explored. Visible contrasts with null object constructions and related argument structure alternations (Null/Unspecified Object Alternations, Levin, 1993 i.a.) allowed by these verbs are also revealed.

Keywords: argument structure, argument alternations, change of state verbs, intransitivity, stativity, causativity.

1. Introduction

Argument structure alternations offer a fruitful topic of research on argument structure and verb meaning—as well as on possible relations linking semantic verb classes with specific syntactic behavior patterns—providing insight into deep structural significances of natural languages. A well-known case of alternation is the one allowed by change of state (COS) verbs like break. These verbs participate in a major type of transitivity alternation, namely the Causative/Inchoative Alternation (see Levin, 1993; Levin and Rappaport Hovav, 1995; Schäfer, 2008; Koontz-Garboden, 2009; Rappaport Hovav and Levin, 2012; Rappaport Hovav, 2014b; Alexiadou et al., 2015, i.a.), illustrated in (1).

(1) a. John opened the door.
   b. The door opened.
(2) a. The toddler shattered the glass.
   b. The glass shattered.

As a result of intense research and discussion over the years, various generalizations have been

1We would like to thank audiences at SuB24 for their comments and discussion on the current work. All errors are our own.
identified, now constituting widely-embraced notions and assumptions bearing on the meaning and behavior of COS verbs. Yet, data from different Romance and non-Romance languages (e.g., Greek) have been recently argued to challenge several of these claims and generalizations (see Mangialavori Rasia, 2017, 2019, to appear).\(^2\) Crucially, such empirical challenges hold up regardless of the specific approach pursued.\(^3\)

For example, consistent patterns in Romance (i.e., Spanish, Italian, Catalan, Portuguese) and Greek pose a problem for the generalized assumption that the internal argument is always present in the Causative/Inchoative Alternation. They also raise questions on the subsequent conclusion that the only variable in the alternation is whether the external argument is present (either deleted, as in Levin and Rappaport Hovav, 1995 i.a., or added in the derivation, as in Hale and Keyser, 2002; Rappaport Hovav and Levin, 2012; Rappaport Hovav, 2014b, a.o.). Romance and Greek data also challenge the notion that the causative frame involves an ‘Event implication rule’ (Hale and Keyser, 2002) holding that if a cause is present, a process is always causally implicated. Such data further challenge the conception of cause(r) interpretation of the external argument depending on (a mere byproduct of) transitivization (as argued in Hale and Keyser, 1993, 2002; Zubizarreta and Oh, 2007; Rappaport Hovav, 2014b). Another corollary put into question is the principle that sole arguments in monadic frames (1b), (2b) are interpreted by default as themes (cf. the Default Linking Rule of Levin and Rappaport Hovav, 1995: 154). In this respect, consider (3).

(3)  “The three linking rules introduced so far do not account for the behavior of all single-argument verbs. They apply only to internally caused verbs, verbs of directed change, and verbs of existence and appearance. But there are monadic verbs that satisfy none of these properties. Here we assume that the default assignment for an otherwise unassigned argument is as a direct internal argument.” (Levin and Rappaport Hovav, 1995: 154)

Apparently, there are two possibilities here. Either all monadic (single-argument) occurrence of COS are expected to yield unaccusative structures (with the unique argument interpreted de facto as theme/undergoer of the designated change), or else, and insofar as unergative structures are indeed possible (according to Romance and Greek data), COS verbs would not ultimately involve the denotations that link them to such a (default unaccusative) behavior (i.e., internal causation, directed change). An interesting question then is the need to reconsider these potential conclusions—especially the first one—in the light of less-known monadic occurrences of verbs widely classified as (internal) COS verbs. In this paper, we extend the discussion to English. The data to be discussed here are still missing from the literature and the general debate on the Causative/Inchoative Alternation—as far as our knowledge goes—even if they promise interesting findings on alternative configurations available for internally-caused COS verbs.

The examples in question (4) instantiate monadic (unique argument) occurrences of verbs generally considered transitive (i.e., supporting argument structure alternations, although invariably involving an internal argument). Yet, what is crucial is that in these constructions

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\(^2\)That is, under the assumption that the internal argument is always present in alternates and variation comes from optional realization of the external argument. This constrains the alternation to two possible frames (dyadic transitive and unaccusative), which is the assumption that we want to discuss here.

\(^3\)Essentially, the major debate on what the most adequate theoretical frame ultimately is (lexically vs. syntactically driven accounts) to account for it classically raised by the Causative/Inchoative Alternation.
the sole argument does not seem to line up with a canonical internal argument as in the Causative/Inchoative Alternation. Instead, these unique arguments—which do serve as grammatical subjects, as in unaccusative variants—are rather interpreted as a cause of the COS than as patients, as expected in monadic forms of the Causative/Inchoative Alternation (under current assumptions). Hence, they significantly deviate from (1)-(2). According to the proposed correlation between syntactic realization and argument (theta-role) identification, the instances under analysis here would involve a structure closer to an unergative frame rather than an unaccusative (inchoative) one. As we will see below, these constructions are limited to monadic frames. Moreover, they show distinct semantic properties that shift as soon as an undergoer (even null/unspecified null object) is licensed. In what follows, we will (provisionally) refer to them as Intransitive Causatives (IC), accordingly.

(4) a. Smoking kills.
   b. Bleach disinfects.
   c. Alcohol dehydrates.
   d. Laser light burns.
   e. Normal dryers wrinkle.
   f. Rice constipates.
   g. Bleach whitens.
   h. Wool itches.

If the above assumption happens to be true (i.e., an unergative layout with a subject interpreted by default as cause), several problems arise. First, and as anticipated, ICs would then fly in the face of central assumptions related to the Causative/Inchoative Alternation. Notably, the general assumption that the internal argument is a constant/invariable constituent across alternating frames (Hale and Keyser, 1993, 2002). They would also fly in the face of the rule predicting that unique arguments in COS verbs are by default interpreted as undergoers (Levin and Rappaport Hovav, 1995, 2005). Instead, ICs suggest that cause interpretation of unique arguments in COS verbs (especially in the internally-caused-change-of-state type, Levin and Rappaport Hovav, 1995; Rappaport Hovav and Levin, 1998; Alexiadou, 2014) is perfectly feasible—or rather, that unergative structures with verbs denoting internal causation and/or directed change (COS) are possible.

ICs also suppose a problem for the so-called Manner/Result Complementarity (Rappaport Hovav and Levin, 2010). In particular, result verbs, i.e., those verbs entailing either a COS (e.g., break, kill) or a change of location (e.g., arrive, send), have been argued to disallow unspecified or unrealized objects (Levin, 1993, 1999). Notably, Rappaport Hovav and Levin (2010) argue that if a verb encodes a COS, the theme—i.e., the undergoer of such a COS—must necessarily be given (overt) lexical-syntactic expression (further see Rappaport Hovav and Levin, 1998; Levin and Rappaport Hovav, 2013, 2014; Rappaport Hovav, 2008, 2014a, 2017; Levin, 1999, 2015, 2017). Result verbs thus contrast with manner verbs (e.g., wipe, scrub)—the opposite type on this partition—, which readily allow unspecified objects/object deletion (cf. All last night, John swept vs. *All last night, John broke). Quite crucially, ICs would instantiate result verbs in intransitive frames with unrealized themes, as analytic data (below) indicates.

Third, ICs show (pure) static behavior. This is somehow unexpected under the general assumption that change denotation and eventivity are part of the core semantic content lexical-
ized in the (COS) verbs relevant to the Causative/Inchoative Alternation (Rappaport Hovav and Levin, 2012; Alexiadou, 2014). Nevertheless, the stativity noted in ICs can be readily explained inasmuch as it correlates with an unergative VP configuration—and to this the absence of a null/unrealized theme is crucial—which is the structure proposed here. This is also especially important since direct mapping between semantic (event) structure and syntactic structure (argument realization) is a hallmark of the Causative/Inchoative Alternation. An unergative syntactic configuration, in line with pure stative behavior—an alternative thus far underexplored—would crucially preserve the (event-syntax) homomorphism expected under this assumption (no internal-argument-licensing structure, no denotation of COS event). Further, stativity could be directly involved in a major crosslanguage divergence setting English apart from other languages which are fully productive in this variant, like Romance. This would uncover a major cross-language asymmetry directly relevant to productivity patterns in the Causative/Inchoative Alternation and the association of certain classes of verbs with it.

The present paper is structured as follows: in Section 2, we analyze the syntax and semantics of Intransitive Causatives, as well as their aspectual properties and their relation to other argument alternations where genericity and stativity are also defining properties. In Section 3, we focus on the productivity of Intransitive Causatives and the verb classes that are productive in this respect. Section 4 concludes the paper.

2. The syntax and semantics of Intransitive Causatives

There are two assumptions that figure prominently in the discussion on the Causative/Inchoative Alternation. The first one is that semantics maps directly into syntax and vice versa. The second is that there is a strict, transparent correlation between (sub)eventive structure and syntactic configuration, as cursorily sketched in (5). This means that a transitive (dyadic) structure will feature two relevant subevents (CAUSE and PROCESS), while a monadic alternate is expected to feature only one subevent (i.e., the PROCESS). Given this direct (event-syntax) mapping, while a dyadic (transitive) construction will be transparently reflected by a complex (two subevents) aspectual structure, a monadic alternate would simply feature an unaccusative structure with a unique argument licensed by the process (COS) layer.

(5) a. \[\text{DP}_1 \text{ CAUSE } \text{DP}_2 \text{ BECOME } \text{STATE}]]\]
   b. \[\text{vP } [\text{DP}_1 \text{ v'} [\text{vP EVENT } [\text{DP}_2 \text{ V'} [\text{V°}]]]]\]

Further, direct (event/syntax) mapping has led to a widely-embraced assumption in constructional(ist) approaches (e.g., Hale and Keyser, 1993, 1997, 2002). The idea is that causation (and the interpretation of the subject as cause) is a purely structural consequence of transitivization (Hale and Keyser, 2002; Zubizarreta and Oh, 2007, i.a.). In other words, the prediction is that cause(r) interpretation of an argument in these verbs will only be possible in dyadic occurrences. More specifically, on such a compositional approach, the possibility to naturally interpret the subject as CAUSE depends on a further derivation. That step takes place when a second head (semantically tied to the denotation of inchoativity/change of state) is embedded under the head licensing the external argument, thus providing the verb with the ability to license an internal argument. In this sense, cause interpretation would be enabled as a result of further structural operations.4

4In principle, this also applies to the assumption that the primary structure is the unaccusative one, which is shared in approaches rather different to Hale and Keyser’s (e.g., Rappaport Hovav and Levin, 2012).
If we want to preserve the transparent, direct (syntax/semantics) mapping claimed—insofar as direct (eventive/syntactic structure) correlation truly holds as an essential property of the causative alternation and COS verbs—the logical solution for a construction only featuring an argument naturally interpreted as cause is that these constructions involve a null/unexpressed object. Another possibility, which has not been widely discussed yet, would be that ICs are monadic constructions in a more radical sense, i.e., unergatives (the sole argument being external, and the sole (sub)eventuality corresponding to the causative layer) and crucially lacking the eventive component.\(^5\) The important point here is that this latter possibility also follows from the same constructional (and derivational) principles outlined above, using the same components (e.g., semantic primes) and syntactic (argumental) positions generally agreed on.

In fact, below we will see that a null object is not traceable in ICs (Mangialavori Rasia, 2019, to appear for detailed argumentation) and that the behavior of ICs is different to null/unrealized object constructions in important respects. Crucially, the proposed syntax is backed up by consistent semantic (aspectual) behavior supporting a natural cause(r) reading of the sole argument independent of transitivity.

2.1. Syntax

There are important reasons to argue that ICs are not null-object constructions. Setting aside the fact that these verbs are not expected to appear with unrealized/null themes on semantic grounds (see Levin and Rappaport Hovav, 1995; Rappaport Hovav and Levin, 1998, 2010), quite crucially, they show patterns deviating from those readily allowed by null, generic, unrealized arguments.\(^6\) Namely, ICs do not allow null-object-oriented depictive predication. Resultative constructions are not possible either.\(^7\)

\[(6)\]
\begin{enumerate}
\item *Smoking kills dead/depressed. \text{SECONDARY PREDICATION}
\item *Smoking kills many.
\item John cooks healthy.
\item John eats a lot.
\end{enumerate}

\[(7)\]
\begin{enumerate}
\item Heat dries tacky/crunchy. \text{RESULTATIVE PHRASE}
\item This product softens *smooth. (cf. It softened smooth)
\end{enumerate}

ICs also disallow adjectival predicates which are instead typically licensed by null/arbitrary implicit arguments (Rizzi, 1986). Null object quantification also fails. For morphological reasons, this failure would translate in Romance into incompatibility with partitive clitic \(\text{NE}\), another widely-used (though not undebated) test for null objects. Reflexive/passive morphology is not allowed either. The examples from Italian and Catalan below are consistent in this regard (8)-(9).

\[(8)\] Fumare (*ne / *si) uccide. \text{(Italian)}
\[
\text{smoke.IFV } \text{NE} / \text{REFL.kill.3SG.PRS}
\]

\(^5\)Note that we take events and eventualities as distinct, well-defined concepts. In this sense, whereas eventualities are used in a broad, general way to encompass both dynamic and stative eventualities, events here refer only to events that have dynamicity as part of their denotation (see Dowty, 1979).

\(^6\)As umbrella terms covering distinct perspectives entertained in the literature.

\(^7\)This is further relevant to the event(ive) characterization of these constructions structurally reflected in syntax, i.e., presence of a further (result) projection with an inner argument as subject.
Returning to English, (10) shows standard examples of reflexive constructions linked to unaccusative structures (from Lundquist et al., 2016: 10), while (11) makes visible the clash of ICs in amenable contexts. Further tests produce similar results; for instance, the incompatibility with (internal-argument-linked) quantifiers, with an Italian well known example (*molti ‘many’, Cattaneo, 2008) in (12).

(10) a. The door opened by itself.
   b. The butter melted by itself.
   c. The boat floats by itself.
   d. The legs move to the beat of their own accord.

(11) a. Alcohol dehydrates (#by itself/#of its own accord).
   b. Rice constipates (#by itself/#of its own accord)

   b. Rice constipates [=causes constipation] (*many/#certain). (English)

Finally, and quite importantly, in Romance, ICs are freely productive with unpassivizable verbs (Object-Experiencer statives like *sadden), but which do allow reflexive/inchoative morphology (viz., clitic _SE_/_SI_). In this respect, the point raised by (14) introduces a major cross-language contrast deserving to be explored in future work, thus bringing up another important reason why ICs should be taken into serious consideration.

(13) a. Las malas noticias (*se) entristecen. (Spanish)
   b. Le notizie cattive (*si) attristano. (Italian)
   c. Les males notícies (*es) entristeixen. (Catalan)

(14) Bad news sadden (*themselves). (English)

Based on these observations—but also on concomitant, semantic ones, given below—we propose that in ICs an unrealized internal argument is not at stake and, further, that cause reading of the subject is crucially independent of transitivity. Importantly, an atransitive structure follows naturally under foundational accounts of the Causative/Inchoative Alternation, such as Hale and Keyser (1992, 1993). More importantly, though, the proposed structure obtains without the need to assume additional stipulations or operations in the argument structure. Let us briefly elaborate.

In structural terms, transitivity is standardly seen as the result of a composition combining two separate heads (Hale and Keyser, 1993, 2002: 106). In contrast to derivational proposals taking either the unaccusative or the transitive frame as basic, the original mainstream derivational

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8In fact, Lundquist et al. (2016: 10) conclude that “by itself” is a test for the absence of a volitional causer and does not tell us anything directly about the causational status of” (further see Levin and Rappaport Hovav, 1995; Alexiadou et al., 2015).

9Specifically, the importance of conceiving the external layer as a noneventive eventuality (Ramchand, 2008, i.a.) or, ultimately, as an event-unmarked one (Hale and Keyser, 1993, 2002).
proposal takes the upper layer in VP as the defective one.\textsuperscript{10} To say that a verb participates in the Causative/Inchoative Alternation hence simply means that “an independent notional type of \textit{V} [which] is a dynamic event” (Hale and Keyser, 1993: 71) (i.e., \(V_2\)) can freely appear as the complement of the monadic configuration yielded by \(\text{V}^0\) (\(V_1\)).

From this perspective, ICs would simply instantiate original \(\text{vP}\) occurrences of COS verbs in a primary stage; that is, before further derivation is operated—basically, the composition with an inner \textit{V} head or \textit{VP} shell (in more Larsonian terms). This second derivation is the one that provides the verb with the ability to license an internal argument, something that in ICs would simply not happen (at least there is no evidence for it, as just shown). Under these conditions, atransitivity therefore represents a logically possible frame for verbs entering the alternation where the combinatorial system naturally allows—apparently, even in English.

In turn, the notion that it is the inner (internal-argument-licensing) \textit{V} head that instantiates the dynamic (COS) event (cf. \textsc{become} in (5) above), which is the second central assumption in most frameworks, including Hale and Keyser’s, leads us to further, consistent data linking syntactic and semantic representation. These facts will be seen next.

(15) Alcohol dehydrates [the cells].

\[ \text{DP}_1 \quad \text{V}_1 \quad \text{V}_2 \quad \text{DP}_2 \]

2.2. Aspect and eventivity

Insofar as direct event/syntax mapping holds in causative alternations, the absence of an internal argument is predicted to correlate with absence of a process (event) component. Interestingly, this seems to be exactly the case in ICs.

Consonant with stativity, in ICs present tense does not yield habitual readings (16)-(17) (cf. Dowty, 1979; Krifka et al., 1995). Also, and unlike transitive causative variants, ICs are infelicitous in frames and contexts generally forcing eventive readings, e.g., \textit{what-x-did} (18) or \textit{what-happened-was} (19) (Cruse, 1973; further see Lakoff, 1976; Jackendoff, 1990; Dowty, 1991; Rappaport Hovav and Levin, 2001).

(16)\textsuperscript{a} a. John disinfects the kitchen. (= John habitually disinfects the kitchen)  
\textsuperscript{b} b. Bleach disinfects. (\(\neq\) Bleach habitually disinfects)

(17)\textsuperscript{a} a. My dad wrinkles my clothes. (= My dad habitually wrinkles my clothes)  
\textsuperscript{b} b. Normal dryers wrinkle. (\(\neq\) Normal dryers habitually wrinkle)

(18)\textsuperscript{a} a. #What alcohol did was dehydrate. (cf. What John did was kill animals)  
\textsuperscript{b} b. #What rice did was constipate. (cf. What the wildfire did was burn the forest)

\textsuperscript{10}According to Hale and Keyser, transitive alternants are obtained through merge of an independent \textit{V} (\(V_2\) in (15)) with the original monadic structure yielded by the \(\text{V}^0\) implicating the external subject (\(V_2\) on this notation). This step is the one that supplies the verb with the capacity to license an internal argument.
(19)  a. #What happened was that shaving creams irritated. (cf. What happened was that the wind broke the window)
    b. #What happened was that bleach disinfected. (cf. What happened was that the earthquake shattered the vase)

Furthermore, ICs resist perception reports (20) and fail to be located in space (21) (see Maienborn, 2007; Rothmayr, 2009). Finally, modals give epistemic readings (22), as opposed to the clear deontic readings seen in eventive predications (23) (Copley, 2018). The latter three observations are crucial, as they not only point to a stative layout, but rather, such behaviors are specifically associated with Individual-Level Predication and, more importantly, with pure states (as opposed to Davidsonian states; see Dowty, 1979; Maienborn, 2007; Rothmayr, 2009, i.a.).

(20)  a. #Tom saw smoking kill. (cf. Tom saw John kill the men)
    b. #Tom saw intense light burn. (cf. Tom saw the fire burn the forest)
    c. #Tom saw normal dryers wrinkle. (cf. Tom saw his dad wrinkle his clothes)

(21)  a. #Bleach whitens in the dry cleaners. (cf. John killed the animals in the forest)
    b. #Rice constipates in the kitchen. (cf. The wildfire burned the forest in that region)
    c. #Wool itches in the bedroom. (cf. The toddler broke the vase in the room)

(22)  a. Smoking must kill.
    OK Smoking probably has property \( x \).
    #Smoking is under obligation to kill.
    b. Intense light must burn.
    OK Intense light probably has property \( x \).
    #Intense light is under obligation to burn.

(23)  a. John must kill the animals.
    OK John is under obligation to kill the animals.
    #John probably has property \( x \).
    b. John must burn the books.
    OK John is under obligation to bum the books.
    #John probably has property \( x \).

To the extent that the derivation proposed above is correct, our prediction holds up, along with the subsequent challenge to several major generalizations on causative-alternating verbs anticipated above. Interestingly, the same transparent mapping traditionally accounting for (1)-(2) would nicely account also for this logical possibility at the same time that it shows that transitivity is not a necessary condition for causativity. Importantly, all this follows nicely—and

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11 Vs. statives with mixed eventive-stative behavior (e.g., ‘davidsonian’ states, on the standard ontology). For instance, statives with mixed eventive behavior in principle allow perception reports as well (see Maienborn, 2007, i.a.) , thus drawing an even deeper contrast with the alleged (pure) stativity of ICs.

12 We consider stativity a welcome result not only because it confirms the expected aspectual (eventive) layout of a construction arguably lacking the internal-argument-licensing component. It is moreover important because it contrasts with the eventive (COS) denotation naturally expected in some covert transitive (say, null/unspecified object) construction. In this sense, we argue stativity—further, of a pure type—supports both the transparent semantics/syntax correlation expected from verbs undergoing Causative/Inchoative Alternation and the proposal of an unergative structure for the same reasons.
quite automatically—from (5) (see above). The relevant addenda—or, rather, caveat—, however, bears on the agreed conception of the causational component as a stative or noneventive eventuality (Ramchand, 2008, a.o.).

In any event, the findings above are crucial insofar as neither these constructions nor the possibility of pure stative behavior in verbs centrally known for allowing Causative/Inchoative Alternation have been discussed in English thus far.

2.3. Genericity and other argument alternations

In this section, we briefly explore English data further reflecting findings in Romance and Greek, bearing on the relation between ICs and middle constructions (Mangialavori Rasia, 2019). In English, as in Romance, ICs share two key properties with middle constructions (e.g., *This vase breaks easily*), namely stativity and genericity. While the former is directly relevant to the analysis for the reasons just exposed, the latter is relevant as it shows a property shared with other types of transitivity alternation.

Regarding genericity, ICs, like middles, do not license episodic readings and do not necessarily refer to actual events that have occurred. Instead, they report an inherent property of the subject. More specifically, ICs instantiate *dispositional generics* (Lekakou, 2005, but see also Schäfer, 2008, i.a.). Such predications are thus true in virtue of the properties inherent to the subject, rather than of whether there were actual events of the specific type in the past denoted by it. As Krifka et al. (1995: 17) note, in such cases, there is no “semantic generalization over events; rather, the generalization would appear to be over characterizing properties of individuals”.

From this perspective, ICs and middles come to contrast with so-called *dispositional habituals* (Krifka et al., 1995) which “assert the existence of a pattern of regularly recurring events” (Lekakou 2008: 256); that is, the latter are true insofar as there were actual events designated by it. Contrary to ICs (24), transitive forms, in examples like (25), are true only if there have been (previous) actual events of hunting wild animals or helping people.

(24)  
   a. Chromic acid burns (... that is why it has never been used before).  
   b. This vase breaks easily (... that is why it is kept inside the box).

(25)  
   a. John helps homeless people.  
   b. US citizens hunt wild animals for fun.

In these respects, both middles and ICs seem to share the genericity of an otherwise eventive predicate. Crucially, however, in the case of ICs, the unique argument is not an internal but an external one. This means that the dispositional property is not attributed to an undergoer of a COS but rather to the cause(r)—due to some inherent property. Restriction to generic tenses is therefore criterial here (26). It helps to contend that ICs’ basic denotation is in line with the definition of so-called *dispositional causation* (Copley, 2018), as defined as in (27). Essentially, ICs also relate a disposer which is the holder of some inherent property, a dispositional state \( d \), a manifestation \( e' \) and a non-episodic eventuality description \( p \). That the disposer \( y \) must have the relevant property in order to be able to generate the COS denoted by the verb (Fara, 2001) naturally falls out.

(26)  
   a. *Smoking killed.  
   b. #Alcohol dehydrated. (cf. Mirabilite quickly dehydrated when exposed to dry air)
c. #Shaving creams irritated. (cf. Foam discolored when exposed to air and glue)
d. #Rice constipated. (cf. Check to see if it wrinkled)

(27) Dispositional causation: (a) y is the holder of e, (b) e is a state that directly causes e’
ceteris paribus, (c) e’ instantiates p, (d) y is disposed toward p. (Copley, 2018: 13)

In addition, and also reflecting Romance findings (Mangialavori Rasia, to appear), generic-
ity draws connections but also important contrasts between ICs and Characteristic Property
of Agent Alternations (e.g., This dog bites, see Levin, 1993: 39). Specifically, two prop-
erties—genericity and the expression of a property attributed to the sentential subject—link ICs to
this other type of (apparent) ‘intransitive’ alternation, but which would be more closely classed
as an unexpressed object alternation. This follows as the patterns seen below are closer to con-
figurations able to license an internal argument (even if null/unrealized), rather than to those
expected in constructions in which this component has not been embedded under v. Notably,
they radically differ in distinct aspect-related properties arguably following from dramatically
distinct underlying argument structure reflecting the desired event/syntax transparency corre-
spondingly. Crucially, (in)transitivity (i.e., a structure with a null/unexpressed object) correlates
with (non)eventive patterns also here.

(28) a. This dog bites (#but it hasn’t bitten anybody yet).
b. Stand back! This horse kicks (#but it hasn’t kicked anybody yet).
c. These cats scratch (#but they haven’t scratched anybody yet).

Moreover, the alternations at hand radically contrast in interpretative and selectional restric-
tions on the subject. While ICs take inanimate entities as subject, Characteristic Property of
Agent Alternations instead select for entities that must qualify as animates—and, moreover, be
agentive to some extent. In this sense, the latter type shows what Dowty (1991: 572) calls “vo-
litional involvement in the event”, adding in turn a strong argument to our claim, i.e., that they
constitute a radically different type of intransitive alternation. Further, the observation is key to
the problem presented next—that is, those aspects in which English shows puzzling contrasts
with Romance and Greek. Crucially, the verb type in such constructions is different: while ICs
are seen in verbs classed as result verbs (COS verbs), unexpressed object alternations involve
manner verbs.

3. The productivity of Intransitive Causatives

Finally, ICs raise a compelling question on causativity and availability of certain types of ar-
gument structure alternation. Clearly, in English not all COS verbs—or, more specifically,
not all (transitive) result verbs classed as COS—are productive for IC. Here, we consider a
tentative answer coming from the so-called Manner/Result Complementarity (Rappaport Ho-
vav and Levin, 2010), especially if combined with proposals like Beavers and Zubair (2013)’s
which argue that verbal roots vary with regards to the type of causing eventuality they select
for—essentially, either a proper event or a state (cf. John broke the window with a hammer
vs. John’s stupidity killed us all). If correct, the data discussed below could provide further
insights into the role played by (verb) lexical content in the capacity to enter certain argument
structure alternations, capturing relevant distributional patterns and productive asymmetries.
3.1. Manner/Result Complementarity and productivity asymmetries

There is a major complementary distribution between verb types. Basically, the so-called Manner/Result Complementarity builds on the premise (e.g., Rappaport Hovav and Levin, 2010, i.a.) that verbs fall in two wide semantic classes, i.e., manner verbs which encode a manner of action (but not a result state from that action), and result verbs which encode a result state (and not the manner of action that brought about such a state) instead.\(^\text{13}\)

(29)  
\begin{itemize}
  \item a. Manner verbs: run, poison, suffocate, wipe, kick, etc.
  \item b. Result verbs: kill, clean, cool, open, shatter, etc.
\end{itemize}

Given the empirical problem at the table, the key point here is that verbs systematically failing to render ICs seem to line up with one of the classes differentiated by this complementarity, i.e., those allowing only manner interpretation. This particular condition could hence receive a natural explanation. Insofar as there is no (root-verb-linked) state interpretation available in the verb, provided the verb only makes reference to a (manner of) action, an IC—recall, an Individual-Level Property related to the potential to eventually give place to a specific state—is, apparently, not computable here. Consider the following examples:

(30)  
\begin{itemize}
  \item a. #This new substance poisons.
  \item b. #The heat in Africa suffocates.
  \item c. #This new product washes.
\end{itemize}

If correct, an interesting observation arises concerning transitivity alternation types and (a)symmetric productivity. Quite interestingly, verbs like \textit{kill}, which encode a result state, freely allow both ICs and Characteristic Property of Agent Alternations (cf. \textit{This dog bites}, see Levin, 1993). Yet, availability of either alternation seems to depend on the (semantic) type of subject involved: while subjects denoting human entities readily yield Characteristic Property of Agent Alternation readings, subjects denoting inanimate entities give in turn IC interpretations. The upshot, it seems, is that that both manner denotation and agentive interpretation block IC productivity.

(31)  
\begin{itemize}
  \item a. John kills (impulsively). (= Characteristic Property of Agent Alternation)
  \item b. Smoking kills. (= Intransitive Causative)
\end{itemize}

Another challenge, which can be also answered on these grounds, now arises. Note that other verbs also classified as verbs of \textit{killing} in the literature (cf. Levin, 1993) do not allow ICs. Apparently, a divergent pattern holds for the (sub)class of verbs restricted by necessarily entailing a result state (say, death). Instead, these verbs yield Characteristic Property of Agent Alternation interpretations. This seems to be the case of \textit{murder, slaughter, massacre, assassinate, slay} and their kin (Ausensi, 2019a, submitted; see also Ausensi et al., 2020).

(32)  
\begin{itemize}
  \item a. CIA spies murder silently. (= Characteristic Property of Agent Alternation)
  \item b. #This poison murders. (cf. This poison kills). (#Intransitive Causative)
\end{itemize}

Now, insofar as certain result verbs like \textit{kill} allow both alternations, the question emerges as to

\(^{13}\)Rappaport Hovav and Levin make the strong claim that a single (simplex) verb cannot make reference to both a manner of action and a result state, i.e., there are no manner-result encoding verbs. Manner/Result Complementarity, in this sense, has been challenged and shown not to hold categorically, see Goldberg (2010), Beavers and Koontz-Garboden (2012, 2017), Ausensi (2019a, submitted).
whether there is coexistence or mutual exclusion of argument structure alternations. According to Ausensi (2019a) (see also Ausensi to appear, submitted), other challenging English data can be accounted for by arguing that verbs like murder (i.e., murder, slaughter, massacre, assassinate and slay) actually encode both a manner of action and a result state. Such verbs would hence deviate from kill, which only encodes a result state. If correct, the basic proposal might help explaining why only verbs of killing of the murder sort, but not of the kill sort, permit ICs, based on (un)availability of manner. If it is true that verbs of the murder sort encode a result state but also a manner of action, the conclusion follows that the latter blocks IC productivity, pointing back to observations just discussed (recall (30)). In principle, murder type verbs restrict the subject to a specific (Agent) type—required by the manner component. This crucially deviates from the basic structure and properties defining ICs. In ICs, the subject only needs to be interpreted as possible cause (see also Folli and Harley, 2005, 2007 on similar restrictions and subject type distribution). Therefore, verbs whose subject needs to qualify as an Agent to some extent (cf. Dowty, 1991) will only yield Characteristic Property of Agent Alternation interpretations accordingly.

Further evidence comes from other verbs also claimed to encode a manner of action and a result state. Notably, so-called manner-of-killing verbs (as opposed to verbs of killing that only encode death but not manner), i.e., guillotine, drown, hang, crucify and electrocute (see Beavers and Koonz-Garboden, 2012) do not produce ICs. For these verbs also, Characteristic Property of Agent Alternation becomes the only possible reading in frames apparently involving a unique argument.14 Specifically here, a subject whose denotation is necessarily computed as ‘human’. (33) a. French revolutionaries guillotine (when they feel attacked).
   b. Romans crucify (when they want to assert power).
   c. Wardens in the US electrocute (when they have no other option).

In short, availability of different (in)transitivity alternations suggest that verbs encoding result states are potential candidates for ICs, whereas verbs that encode a manner of action component—either only manner or both manner and result—disallow ICs, yielding Characteristic Property of Agent Alternation readings in turn.

Now, consider this: arguably, result verbs are derived from roots that denote states (Rappaport Hovav and Levin, 2010, but see also Alexiadou et al., 2015; Rappaport Hovav, 2017; Levin, 2017). Apparently, the fact that result roots denote states makes verbs derived from such roots compatible with IC derivation. In principle, this stands insofar as ICs basically denote that the causer subject holds an inherent property allowing it to enter the universe of entities capable of triggering the state named by the root—i.e., insofar as Smoking kills can be (re)paraphrased as Smoking (has the ability to) cause death, and taking death as the state the root names—due to some inherent property (e.g., because tobacco contains cancer-causing chemicals). By contrast, manner verbs are taken to derive from roots that denote actions but not (potentially caused) states. This type can hence be expected to disallow ICs. In principle, there would be no state available in these verbs’ denotation (potentially) triggered by the cause(r), which is essentially what ICs predicate.

14Given that Characteristic Property of Agent, as event tests shows, does necessarily involve an inner V—and, quite probable, an unspecified/null object—, contrary to ICs.
3.2. Manner/Result Complementarity and unexpressed objects

As already mentioned, ICs pose a problem for Rappaport Hovav and Levin (2010)'s claim that (transitive) COS verbs disallow unspecified objects.\textsuperscript{15} This particular problem is also important in the frame of Manner/Result Complementarity. Specifically, Rappaport Hovav and Levin claim that the distinction between manner and result denotation is grammatically relevant, as verbs classed as manner and result differ in argument realization. While canonical manner verbs (e.g., \textit{sweep, run}) permit unspecified and nonselected objects, canonical result verbs like \textit{dim} or \textit{break} (apparently) do not. Quite crucially, ICs instantiate cases of result verbs with (apparent) unrealized themes (e.g., \textit{wrinkle, whiten, burn})—actually, without theme-licensing structure at all.\textsuperscript{16}

\defcounter{refsection}{0}
\begin{enumerate}
\item All last night, John swept. \hspace{1cm} \textbf{MANNER}
\item The joggers ran the pavement thin. (Levin and Rappaport Hovav 1995: 53)
\end{enumerate}

\defcounter{refsection}{0}
\begin{enumerate}
\item *All last night, John broke. \hspace{1cm} \textbf{RESULT}
\item *We dimmed the room empty. (Rappaport Hovav 2008: 23)
\end{enumerate}

Interestingly, Rappaport Hovav and Levin’s basic assumption can in fact provide a strong argument for assuming an unergative structure. Let us flesh out the idea. According to Rappaport Hovav (2008: 24), the difference in argument (un)realization follows from the fact that result verbs lexicalize scales of change and such scales “require that the participant whose property is measured by them be overtly realized”. Result verbs would hence not permit unspecified objects or nonselected objects insofar as these involve nonrealization of a mandatory argument. Yet, syntactic evidence consistently shows that ICs behave quite differently from null/unspecified object constructions. In this sense, an unergative structure emerges as a more likely option to explain data such as ICs.

An atransitive verb configuration in keeping with unergative syntax also makes sense in semantic terms for various reasons. Namely, Levin (2017: 583) argues that the objects of result verbs must be expressed based on the principle that “to know that a state that holds requires looking at the entity it holds of”, which she calls the ‘Patient Realization Condition’. Result verbs therefore “cannot be found with unspecified objects or nonselected objects, nor can they be found in constructions where anything but their patient argument is the object” as a consequence of this semantic condition. In this respect, ICs are not necessarily a problem to Rappaport Hovav and Levin’s claim for a simple reason: they predicate over the subject (the cause). That is, they do not necessarily counterexemplify such a principle but rather merely escape it. The argument holds also on syntactic grounds, as ICs instantiate atransitive variants of result verbs in objectless constructions with consequent semantics: the state named by the COS verb does not hold of the theme but rather of the causer—and, if any scalar property is involved related to the verb root denotation, it would be associated to the thematic role cause(r).\textsuperscript{17} Thus, ICs fall outside the

\textsuperscript{15}We keep the original terminology by Rappaport Hovav and Levin (2010), which is not necessarily the one embraced in our account, and which can turn out specifically problematic for a constructional framework—or else for a lexically-based theory taking these verbs not as basic transitives (e.g., basic unaccusatives, cf. Rappaport Hovav and Levin, 2012).

\textsuperscript{16}Rappaport Hovav and Levin’s claim that result verbs necessarily disallow nonselected and unspecified objects has been previously questioned, see Goldberg (2001); Rissman (2015); Mateu and Acedo-Matellán (2012); Ausensi (2019b, to appearb).

\textsuperscript{17}Think of Romance examples like \textit{La mantequilla engrasa ?mucho/bastante} ‘Butter greases (causes greasiness)
scope of the Patient Realization Condition for semantic and for syntactic reasons: there is simply no object deletion, nonrealization nor null/unspecified internal (theme) argument licensing. Instead, ICs would provide strong counterevidence only if the Patient Realization Condition is rather held as a sweeping restriction on COS verbs, strictly limiting them to transitivity.\(^{18}\)

The same observation can be posed for a different but closely related argument. Notably, Beavers and Koontz-Garboden (2012) point out that the key difference between manner and result verbs in argument realization actually follows from Rappaport Hovav and Levin’s (2001: 779) Argument-Per-Subevent Condition, as defined in (36). From this perspective, manner and result verbs differ in their (sub)event structure. Essentially, manner verbs are simple: they only involve one subevent (37a), i.e., an action. By contrast, result verbs would be more complex—they involve two distinct subevents: a causational eventuality and an eventive component expressing the COS (BECOME in (37b)).

\[(36) \quad \text{Argument-Per-Subevent Condition: There must be at least one argument XP in the syntax per subevent in the event structure.}\]

\[(37) \quad \text{a. } [x \text{ ACT } <\text{ROOT}>] \]
\[\text{b. } [ [x \text{ ACT}] \text{CAUSE} [y \text{ BECOME } <\text{ROOT}>] ] ]\]

The Argument-Per-Subevent Condition makes two predictions. First, that result verbs will disallow constructions where the patient, whose property is measured out, is not overtly expressed—which would be the case for nonselected objects or unspecified object constructions. Second, manner verbs will in turn allow nonselected objects as well as unspecified objects as they do not encode any result, and therefore do not involve an inner subevent whereby a property (result) is ascribed to a theme. Another tentative derivation, however, would be that only manner verbs can be intransitive in the sense that (36) holds only for derivational accounts taking the complex structure as basic.

Turning back to ICs, two observations emerge: first, ICs would escape the Argument-Per-Subevent-Condition for the same reasons just raised in answer to the Patient Realization Condition. Also here, ICs would contradict the condition if and only if seen as an inescapable productivity restriction, or else if internal-argument-licensing was conceived as some necessary syntactic condition on these verb roots.

Again, data clearly show that there is not a patient in ICs (whose property is measured out) which is not overtly expressed or unspecified for different semantic and syntactic reasons just summarized in relation to the Patient Realization Condition. Moreover, the basic notion behind (37a) is, ultimately, consistent with our proposal. As only the upper layer is realized in ICs it follows that a cause eventuality, correctly correlated with the presence of an external argument, will be the basic composition behind ICs, and hence the only predicational relation at stake. That is, a simplex (single) eventuality composition.

Significantly, IC productivity in English involves other relevant asymmetries which, for reasons a lot/enough”; and how they could, if ultimately tolerated, only be computed as gradable properties ascribed to a cause (i.e., degree to which butter bears the relevant inherent property) but not as null/unspecified quantifier (i.e., *Butter greases many).\(^{18}\)

\(^{18}\)Or, at least, for defective or mandatory licensing of internal arguments. Of course, this also depends on the type of VP derivation assumed (e.g., derivational vs. nonderivational accounts).
of space, we will not elaborate on in detail here.19

4. Conclusion

In this paper, we focus on what we have called Intransitive Causatives, i.e., intransitive realizations of COS verbs in English. ICs are important as they pose problems for some widely-adopted assumptions in the literature on argument structure and verb alternations. Notably, the idea that sole arguments in COS verbs are defectively interpreted as themes (cf. Default Linking Rule, Levin and Rappaport Hovav, 1995, 2005). Conversely, ICs show that the interpretation of a sole argument as cause is possible and natural with these verbs, but also that non-realization of the internal argument systematically correlates with lack of COS-event instantiation (attributed to the internal-argument licensing head). This, in turn, poses a challenge and invites to a necessary reconsideration of more specific characterizations of COS verbs based on semantic and/or syntactic restrictions generally tied to argument realization. Two specific cases introduced here are the Patient Realization Condition and the Argument-Per-Subevent-Condition, where transitivity (internal-object licensing) of COS verbs and a well-known distribution—Manner/Result Complementarity—are intertwined. We note that Manner/Result Complementarity could capture important and interesting productivity restrictions seen in English, along with issues like the (un)availability or coexistence of distinct argument structure alternations for certain verb classes. Semantic properties on which such a complementarity builds could likely explain productivity patterns and regularities, whereby English visibly differs from other languages like

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19There is a final issue about IC productivity here taking us back to Manner/Result Complementarity. It might be clear that that not all result verbs, i.e., those that only encode a result state, allow ICs in English. In this respect, canonical result verbs like break, destroy, shatter, etc., seem to systematically resist ICs.

(i) a. ??A strong gust of wind breaks. (cf. A strong gust of wind broke the windows)
   b. ??Wildfires destroy. (cf. A wildfire destroyed the city)
   c. ??Earthquakes shatter. (cf. An earthquake shattered all the plates)

To account for these patterns, we suggest that Beavers and Zubair (2013)’s hypothesis might be worth exploring. The backbone of the proposal, recall, is that verbal roots appear to select for the type of causing eventuality. In this respect, Beavers and Zubair argue that certain verbal roots are specified for the type of causing eventuality they allow for. On their account, causing eventualities fall in two types, namely events or states. They observe that there are verbal roots such as kill or break that are actually unspecified for the type of causing eventuality and therefore allow both events and states as causing eventualities. See the examples below.

(ii) a. John killed all the citizens with this machine gun.
   b. John’s stupidity killed all the citizens (as he forgot to warn them about the incoming hurricane).

Other verbal roots, such as murder, would be specified for a causing eventuality that is an event and therefore disallow states.

(iii) a. John murdered all the citizens with this machine gun.
   b. #John’s stupidity murdered all the citizens (as he forgot to warn them about the incoming hurricane).

A possible solution for the problematic data at hand could come from the identification of a third type of causing eventuality—say, dispositional properties—for, namely, the type of causation (dispositional) seen in ICs. A gradient would thus ensue. Verbs like kill would be, in principle, unspecified for the causing eventuality since they allow for events, states and dispositional properties as causing eventualities (hence, the data above). Break (and its kin), on the other hand, would select for either events or states but not for dispositional properties, therefore disallowing ICs. Finally, verbs like murder would be highly specified in the sense that only events are permitted, unproductivity of ICs automatically follows accordingly.

(iv) a. John broke the vase with a hammer.
   b. John’s irresponsibility broke the vase (as he left it out in the yard on a windy day)
   c. *A strong gust of wind breaks.

We are not unaware that the answer is somehow stipulative and ad-hoc. Future work is needed to establish whether an additional type applies to other empirical instances or render relevant to capture wider systematicities.
Romance.

References


Abstract. In this paper we propose an analysis of prohibitive and expletive negation that relies on two ways of building negative priorities. Our empirical ground is the diachronic development of expletive negation from Latin to French. We show that the negative expression *ne* (from Indo-European *mē*) is found in two contexts in Latin: imperatives and priority attitudes. We propose a unified semantics for these contexts, that leaves room to accommodate a distinction between positive (e.g. *order/wish*) and negative (e.g. *forbid/fear*) priority attitudes. We argue for an ambiguity account of *ne* driven by these two types of attitudes, and argue for a distinction of a prohibitive *ne* acting as a true negation in the context of imperatives and positive priority attitudes and an expletive *ne*, reversing the ordering relation encoded in the lexical semantics of negative priority attitudes. We extended the analysis to expletive negation in the context of epistemic attitudes conveying a meaning of contrariness such as *doubt* or *deny* thus establishing a unified semantics for negative attitudes that cuts across priority and epistemic ones.

Keywords: priority modality, attitudes, speech acts, negation.

1. Introduction

Expletive negation is the cross-linguistically attested form/meaning mismatch whereby a negation marker appearing in a complement clause does not contribute proper negative meaning. Expletive negation does not occur randomly, and across languages a large variety of triggers have been identified. Not all languages feature all triggers, but there is some overlap cross-linguistically (see Yoon (2011), for the most recent inventory). Among the core contexts that license expletive negation *ne* in French – the language under scrutiny here – and across languages, we find attitudes expressing apprehension (1), doubt (2) verbs, as well as before-type of clauses, (3) and comparatives, see (4).

1. *Je crains* qu’on *ne* nous ait entendus.  
I *fear* that 3SG.CL *ne* 2PL.CL have.3SG.SUBJ heard  
‘I *fear* that someone heard what we were saying.’

2. *Personne* *ne* *doute* que tu *n’* en *sois* capable.  
Nobody *NEG* doubts that you *ne* it.ACC be.3SG.SUBJ capable  
‘No one *doubts* that you are able to do it.’

3. *Partez avant* que *je* *ne* change d’avis.  
Leave.IMP before that I *ne* change.1SG.SUBJ my mind.  
‘You should leave *before* I change my mind.’

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(4) Je me crois plus fort que je ne le suis.  
I 1SG.REFL believe more strong than I 3SG.SUBJ  
‘I think of myself as stronger than I am.’

In this paper, we will follow the insight of some previous studies that have pointed to a relation between expletive negation in modern languages (and in particular Greek) and the so-called Indo-European prohibitive negation, dedicated to the construction of negative imperatives. Chatzopoulou (2012), for Greek, observed that the same morphological form NEG₂, min (as opposed to the standard propositional negation NEG₁, dhen) occurs as a negative element in imperative clauses, see (5), while it occurs as an expletive element with attitudes like fear (see (6)).

(5) Min féris ton Jání!  
NEG₂ bring.2SG the.ACC John.ACC  
‘Don’t bring John!’

(6) Fováme na min erthi.  
fear.PRES.1SG SUBJ NEG₂ come.3SG  
‘I fear that he comes.’

We will show that Latin NEG₂ (ne), like its Greek counterpart, is used to build a negative priority (negative command, wish, or permission). More specifically, we will argue that negative priorities come in two types. Negative priorities can be formed of an imperative operator or what we call a positive priority attitude (eg. wish/order) followed by a semantically plain ne, see (7), (8). They can also be formed of a negative priority attitude (eg. fear/forbid) followed by an apparently semantically empty ne, see (9).

(7) Ne vivam si tibi concedo.  
NEG₂ live.1SG.SUBJ if you.DAT abandon.1SG  
‘May I not live if I let you down.’ (Cic, Epis, 2.209)

(8) Velim ne intermittas.  
wish.1SG NEG₂ stop.2SG.SUBJ  
‘I wish that you will not stop.’ (Cic, Epis, 11.12.4.6)

(9) Timeo ne laborem augeam.  
fear.1SG NEG₂ work.ACC increase-1SG.SUBJ  
‘I fear that I shall increase my work.’ (Cic, Leg, 1.4)

Our analysis will substantiate the descriptive categories ‘positive’ and ‘negative’ priority attitudes (see section 3), by fine-tuning a unified modal semantics for imperatives and priority attitudes, which leaves room to accommodate key differences between two ways of building negative priorities. We will thereby propose an ambiguity account where ne contributes negative meaning only when it is prohibitive; we will argue that, in the context of negative priority attitudes, expletive ne operates over the ordering source of the attitude by spelling out a negative component lexically encoded in the meaning of the verb. We will show that this ambiguity of ne found in Latin is lost in French, where only expletive ne survives, also appearing in new environments. We argue that solitary prohibitive ne undergoes the Jespersen Cycle and is no longer found in this language. In section 2 we discuss current theories of expletive negation by highlighting the main points of overlap with our account. In section 3 we present our diachronic
study. Section 4 is devoted to the semantic analysis and its (diachronic) predictions. Section 5 offers further predictions, discussing epistemic verbs triggering expletive negation. Section 6 concludes.

2. Previous approaches

Among the many proposals (Muller (1991); Tovena (1996); Zanuttini and Portner (2000); Abels (2005); Eilam (2009); Makri (2013); Jin and Koenig (2017)), we will focus on two major approaches to expletive negation in attitude contexts. The first treats expletive negation as a Negative Concord item, while the second treats it as a mood morpheme with a comparative semantics.

2.1. Expletive negation as a Negative Concord Item

Zeiljstra (2004) and Espinal (2007) posit that expletive negation and the main verb do enter a Negative Concord relation with each other, yielding a ‘single-negation’ semantic reading. Espinal’s proposal consists in a Negative Concord analysis of the relation between nonveridical predicates (non-implicative predicates $F$ such that $F(p)$ does not entail $p$ Giannakidou (2009)) and expletive negation. According to Espinal, only the main predicate is interpreted as semantically ‘negative’, while the negation marker in the subordinate clause is interpreted as a dependent concord item. The idea of a deep connection between the negative semantics of the predicate and expletive negation is important and we will maintain it here. However, there are several non-veridical predicates that do not trigger expletive negation (e.g. belief or command verbs), and our diachronic analysis will help us to pin down the negative contribution of the predicate at the level of its modal comparative semantics rather than at the level of its nonveridical property. In our account expletive negation does not enter a Negative Concord relation to the main predicate. We will rather propose that expletive negation is the overt spell out of a negative component in the main predicate’s lexical semantics, which fulfills the specific task of reversing the preferences encoded in the comparative semantics of the attitude.

2.2. Expletive negation as a mood marker

Yoon (2011) posits that in Korean, although expletive negation is morphologically identical to standard negation, it does not play the role of a standard negation marker but that of a subjunctive mood marker (see also Zovko-Dinkovic (2017)). In the line of reasoning of Giannakidou (2009), Yoon assumes that the subjunctive mood is licensed by nonveridical predicates as a Negative Polarity Item. Within this perspective, subjunctive mood is conceived as a semantically dependent morpheme, which does not actively contribute to meaning, but has a certain definedness condition that restricts its distribution to the scope of nonveridical predicates (see also Giannakidou (2009)). Yoon argues that expletive negation is a subjunctive mood marker that conveys a scalar (or evaluative) meaning. According to Yoon’s analysis, expletive negation (abb. EN in (10)) imposes an ordering on the modal base $M_B$ of verbs fear, ranking $\neg p$-worlds higher than $p$-worlds on a desirability scale.

(10) Scalar semantics for expletive negation with fear (Yoon, 2011: p.161):
    a. If fear $(x,p)$ is true in a context $c$, then $M_B(x) \cap p$ is not $\emptyset$ in $c$. 
b. The evaluative component of $\text{EN} (x, p)$ expresses in context $c$ as the following:

$$M_B(x) - p \succ_{\text{Desirability}} M_B(x) \cap p \text{ in } c$$

In line with Yoon (2011), our analysis will recognize a connection between expletive negation and orderings, but we will abandon the idea that expletive negation is triggered by non-veridicality, as this assumption would overgenerate the use of expletive negation; indeed non-veridical predicates such as $\text{believe}$ and $\text{hope}$ do not licence expletive negation. Our empirical study allows us to identify a subclass of nonveridical environments that trigger expletive negation. Our analysis will substantiate the idea that expletive negation realizes the preference for the low-ranked worlds, as already encoded in the modal preferential semantics of the triggers.\footnote{Note that in French $\text{ne}$ cannot be used with verbs such as $\text{hope}$, whereas this type of predicates trigger expletive negation in Koren. This seems to justify a different – but related – take on the question of the distributions of expletive negation.}

3. Prohibitive and Expletive $\text{ne}$ from Latin to French

In Classical Latin (roughly from 150 BC to 300 AD), negative imperatives are formed with the negative marker $\text{ne}$, which might originate from Proto-Indo-European prohibitive negation $\ast \text{mē}$ (see Löfsted (1966)). It mostly combines with the subjunctive mood, see (11). The choice of the standard negation $\text{non}$ is associated with the indicative mood, as shown in (12).

\begin{equation}
\text{(11)} \quad \text{Ne} \quad \text{vivam} \quad \text{si} \quad \text{tibi} \quad \text{concedo}.
\end{equation}

$\text{NEG}_2 \text{live.1SG.SUBJ} \text{if you.DAT} \text{abandon.1SG}$

‘May I not live if I let you down.’ (Cic, $\text{Epis}$, 2.209)

\begin{equation}
\text{(12)} \quad \text{Illud} \quad \text{mihi} \quad \text{verbum} \quad \text{non} \quad \text{placet}.
\end{equation}

$\text{this.ACC} \text{me} \text{sentence} \text{NEG}_1 \text{like} \text{what} \text{now} \text{have}$

‘This phrase, ‘What you have now’, doesn’t please me.’ (Pl, $\text{Aul}$, 547)

It is a well-known fact that imperative clause type is a notional category that can have different flavors in context. Condoravdi and Lauer (2012) and Kaufmann (2012) propose a typology of imperatives, whereby they can be interpreted as commands, wishes and permissions. Each one of these main flavors features a variety of subflavors.\footnote{According to Condoravdi and Lauer (2012) these are subtypes of speech-acts.}

1. **COMMAND-type:**

\begin{equation}
\text{(13)} \quad \text{Nimium} \quad \text{est} \quad \text{!} \quad \text{– Ne} \quad \text{clama}.
\end{equation}

$\text{Excess.ACC} \text{is} \quad \text{!} \quad \text{– NEG}_2 \text{shout.2SG.IMP}$

‘That’s too much! – Don’t shout.’ (Ter, $\text{Ph}$, 664)

\begin{equation}
\text{(14)} \quad \text{Uigila,} \quad \text{ne} \quad \text{somno} \quad \text{stude}.
\end{equation}

$\text{Stay-awake.2SG-IMP}, \text{NEG}_2 \text{sleep.DAT} \text{seek-for.2SG-IMP}$

‘Open your eyes, don’t fall asleep.’ (Pl, $\text{Mil}$, 215)

\begin{equation}
\text{(15)} \quad \text{Ne} \quad \text{parce} \quad \text{uocem, ut audiat}.
\end{equation}

$\text{NEG}_2 \text{spare.2SG-IMP} \text{voice.ACC}, \text{so-that} \text{hear.3SG.SUBJ}$

‘Don’t talk quietly, so that he can hear you.’ (Pl, $\text{Mil}$, 1220)
(16) Actum, auint, no agas. (Advice)
done, say.3PL, NEG2 do.2SG.SUBJ
'Don’t, as they say, deal with done business.' (Ter, Phorm, 419)

(17) Ignosce, irata no sies. (Plea)
forgive.2SG-IMP, angry NEG2 be.2SG.SUBJ
'Forgive me, don’t be angry at me.' (Pl, Amph, 94)

2. **Wish-type:**

(18) Ne magis sim pulcer quam sum. (Addressee-less wish)
NEG2 more be.1SG.SUBJ beautiful.NOM than be.1SG-IND
'May I not be more beautiful than I am.' (Pl, Mil, 1086)

(19) Ne di sirint! (Absent wish)
NEG2 gods.NOM allow.3PL
'May the gods not allow it!' (Pl, Amph, 613)

3. **Permission-type:**

(20) Haec negat se tuam esse matrem. – Ne fuat se non
This-one.NOM.FEM denies CL your be mother.ACC. – NEG2 be.3SG.SUBJ if ne
uolt. (Permission/concession)
want.3SG-IND
'She says she’s not your mother. – Let her not be if she doesn’t want to.'
(Pl, Epid, 584-5)

As for ne appearing in embedded clauses, we observe that it appears with priority attitudes.4 We also observe that priority attitudes come in two sorts: they can either be positive (for instance impero ‘order’) – conveying that p is conform to the laws – or negative (for instance prohibeo ‘forbid’) – conveying that p is not conform to the laws. In the case where positive priority attitudes are followed by ne, ne maintains its negative meaning, see (21a). However, with negative priority attitudes, ne does not add visible negative meaning in the same way as it does with positive priority attitudes, see (21b).

(21) ‘Don’t shout!’

a. Impero ne clama.
Command.PRES.1SG NEG2 call.2SG.IMP
‘I order you not to shout.’

b. Prohibeo ne clama.
Forbid.PRES.1SG NEG2 call.2SG.IMP
‘I forbid you to shout.’

Importantly, there is a strong parallelism between the range of flavors that imperative may have in context and the range of meanings that priority attitudes embedding ne may have. As for the positive priority attitudes, we see attitudes of ordering (impero, ‘I order’), warning (moneo,

- **COMMAND-type**
  - Impero (‘order’)
  - Prohibeo (‘forbid’)
- **WARNING-type**
  - Moneo (‘warn’)
  - Impedio (‘prevent’)
- **REQUEST-type**
  - Rogo (‘ask’)
  - Recuso (‘refuse’)
- **ADVICE-type**
  - Suadeo (‘advise’)
  - Dissuadeo (‘dissuade’)
- **PLEA-type**
  - Obsecro (‘beg’)
  - ?
- **WISH-type**
  - Opto (‘wish’)
  - Timeo (‘fear’)

Summarizing, the same negative element ne is found in matrix negative imperatives and in embedded contexts. The attitudes that trigger ne in their embedded clause are priority attitudes. These attitudes can be positive with ne bearing negative content or negative with ne contributing *prima facie* no negative content.

As a quick view of what happens in French, expletive negation is found with negative priority attitudes.

- **COMMAND-type**
  - Défendre (‘forbid’)
- **REQUEST-type**
  - S’opposer à (‘refuse’)
- **WARNING-type**
  - Empêcher (‘prevent’)
- **WISH-type**
  - Craindre (‘fear’)

Expletive negation is also found in a series of new contexts and most notably comparatives, *less-than* clauses, *before*, *unless* and *without* clauses.

(22) Mout est prez la mors - plus que noz ne penssonz. Much is close the death - more that we ne think.1PL.IND
‘Very close is death - *more* than we think.’
(Gautier de Coinci, *Miracles de Notre-Dame*, 1218)

(23) Ne fui gueres asecuree, or ma seur, meins ke einz ne fis. ne be.1SG not safe, now my sister, less than before ne be.1SG.PAST
‘I’m not safe from danger, now my sister, *less* than I was before.’
(Hue de Hotelande, *Ipomédon*, 1180)
(24) Mons. de Berry vendist sa vesselle pour nourrir ses gens, disant qu’ il aymoit Mr. de Berry sold his crockery to feed his people, saying that he wanted mieux x menger en vesselle d’ estain et de boys avant que ses gens ne better eat in crockery of tin and of wood before that his people ne fussent nourris. be.3PL.PAST.SUBJ fed (Jean Le Clerc, *Interpolations et variantes de la chronique scandaleuse*, 1502) ‘Mr. de Berry sold his crockery to feed his people, saying he would rather eat in tin and wood crockery before his people would be fed.’

(25) Si tu vouloys prendre les [oyseaulx] sauvages [...] ils ne vouldroient If you wanted take the birds savages [...] they NEG want pondre estants ainsi assubjectis et serrez, à tout le moins que ce ne lay-their-eggs being thus subjected and oppressed, unless that CL ne fust bien tard. be.3SG.SUBJ much late. ‘If you were to take savage birds, they wouldn’t want to lay their eggs, being subjected and oppressed, unless it would be very late.’ (Claude Cottereau, *Les douze livres*, 1551)

(26) ”Que la gloire te demeure sans qu’ on ne May the glory PRO.2SG remain.3SG.SUBJ without that PRO.3SG ne diminuie une seule goutte.” diminish.3SG.SUBJ one only drop (Jean Calvin, *Institution de la religion chrestienne*, 1560) ”May the glory remain yours without any piece of it be diminished.”

4. Analysis

We offer an analysis for the Latin data where *ne* combines with imperatives, positive priority attitudes and negative priority attitudes to deliver a negative preferential meaning. This analysis allows to predict the diachronic development of expletive negation, most notably in contrast to propositional negation.

The correspondence between imperatives and attitudes of command has not escaped theoreticians, and Katz and Postal (1964) Sadock (1974) have advanced the hypothesis, known as the Performative Hypothesis, of a correspondence between imperatives and priority attitudes. This view makes some specific assumptions about the structure of imperatives and the corresponding attitude sentences, whereby an imperative clause has an abstract operator *IMP* in the deep structure, which can be spelled out by an attitude like *I order*. According to this idea, what the operator *IMP* and the attitudes that paraphrase it have in common is a performative meaning.

However, this idea has some limitations. Besides those noted by Portner (2018), the immediate difference between the two is that the attitude report does not always have a performative meaning. This is most prominently the case when the attitude is not in the first person (*I order*...
that you close the door vs. She orders that you close the door). For this reason, we are reluctant to encode a performative meaning in the attitude itself.

To capture the common core of imperative and priority attitudes, following Portner (2007) Kaufmann (2012) Hinterwimmer et al. (2019) we assume that they share a modal meaning. Likewise for attitudes, we will rely on Giannakidou and Mari (2021), who propose a unified semantics for attitudes and modals. Given this common modal denominator cutting across imperatives, attitudes and modality, we adopt the standard Kratzerian framework resorting to modal bases \((M)\) and ordering sources \((O)\), which we will anchor to individuals. One important novelty in our account is that with imperatives, the anchors of the modal base and the ordering source are not the same.

We align with the idea that imperatives are flexible with respect to their ordering source Portner (2007), therefore accommodating different contextual flavors. For simplicity here, for command-type imperatives, we assume that the ordering source is ‘what the speaker/laws order’; for wish-type imperatives, we assume that the ordering source is ‘what the speaker wishes’ (for recent discussion Giannakidou and Mari (2021)). We encode the addressee’s preferences for action \((\text{Pref} \text{Act}_j)\) in the modal base of imperatives. The preferences of the speaker partition this modal base into possible actions of the addressee that conform to the speaker’s order/wishes etc. We use \(j\) for the addressee.

(27) Imperatives.

\[
\forall w' \in \text{DEON}_i(\text{Pref} \text{Act}_j) \ p(w')
\]

For the attitudes, the modal base and the ordering source are lexically specified and none of them is parametric to the addressee.

(28) Order-type attitudes.

\[
\forall w' \in \text{DEON}_i(\text{Dox}_i) \ p(w')
\]

---

6See discussion in Portner (2007) and Hinterwimmer et al. (2019) for the divergences between the two.

7This allows us to account for the fact that the imperatives relate to possible actions, in the spirit of Portner (2007).

8The imperative request is satisfied if the addressee carries about an action that is in the domain carved by the orders of the speaker; but nothing in the semantics implies that she will.
Returning to *ne*, our claim is that it comes in two guises: prohibitive and expletive. It is prohibitive in the context of root imperatives and positive priority attitudes. It is expletive in the context of negative priority attitudes. With these distributions in mind, we can now provide a semantic content to the labels ‘prohibitive’ and ‘expletive’. We propose that prohibitive-*ne* is a standard negation that scopes over the TP. In this case, *ne* does not differ in content from declarative negation. The only difference with declarative negation is that prohibitive-*ne* is triggered by priority modals. As we see in (29) and (30), the prohibitive-*ne* produces the expected meaning according to which the order targets a negative proposition.

(29) Negative imperatives.

\[ \forall w' \in DEON_i(\text{PrefAct}_j) \neg p(w') \]

(30) Negative order-type.

\[ \forall w' \in DEON_i(\text{Dox}_i) \neg p(w') \]

To understand the role of expletive-*ne* with negative priority attitudes, we need a basic toolkit. First, we assume that modal bases \( M \) contain only worlds that are question sensitive. In other terms, we exclude far-fetched worlds. Second, ordering sources restrict the modal base to those worlds that comply with them. In our definition, we consider an all-or-nothing configuration where the worlds delivered by the ordering are those worlds in the modal base \( M \) in which all the propositions in the ordering source \( P \) are true.

(31) \( O(M) = \{ w' \in M : \forall q \in P \ w' \in q \} \)

Given (31), we define the negation of the ordering as in (32). According to the definition, \( \text{NEGATIVE-O}(M) \) worlds are those worlds in the modal base in which *none* of the propositions in the ordering source are true.

(32) \( \text{Neg-O}(M) = \{ w' \in M : \forall q \in P \ w' \notin q \} \)

With von Fintel (1999), Giannakidou and Mari (2016, 2018a, b), we assume that human ne-
cessity requires that the modal base be compatible with both $p$ and $\neg p$. Let us now consider the FORBID/FEAR-type of attitudes and substantiate the component of contrariness that they involve (Espinal, 2007). ORDER-like predicates introduce an ordering that can be paraphrased as ‘in accordance with the laws/the orders of the attitude holder’. FORBID-like predicates introduce an ordering source that can be roughly paraphrased as ‘contrary to the laws’. Forbid/fear $p$ conveys at the semantic level that $p$ is not compatible with what the attitude holder orders/wishes. To grasp the meaning of contrariness encoded in negative priority attitudes, we claim that there is a silent negative operator over the ordering source, and that the semantics of the FORBID/FEAR-type of attitudes is as follows.

\[(33) \text{Forbid/fear-type.} \]

\[
\forall w' \in \text{Neg-DEON}_i(\text{Dox}_i) \ p(w')
\]

\[
\begin{array}{c}
\text{FORBID/FEAR} \\
\lambda M \lambda O \lambda p \\
[\forall w' \in O(M) \ p(w')] \\
\text{Neg-DEON}_i \\
\text{ne} \\
\text{DEON}_i
\end{array}
\]

$\text{NEG-O}_i$ is the set of worlds that do not comply with what the attitude holder $i$ orders or wishes. Negative priority attitudes, by quantifying over $\text{NEG-O}_i$ worlds state that, in these worlds, $p$ is true. Since $p$ is in the complement set of the propositions delivered by $O_i$ (the laws according to what the attitude holder orders or wishes), $p$ is conceived as ‘contrary’ to what the attitude holder orders or wishes.

A non-defeasible inference arises that $\neg p$ is in accordance with the laws. Recall that $\text{NEG-O}$ partitions the modal base in two parts, one in which the propositions in the ordering source are true, and one in which none of them is true. By quantifying over the first set, the attitude conveys that, in the worlds that comply with the negative ordering source (i.e. those worlds which do not comply with the laws), $p$ is true. The inference arises that if $p$ is true in the worlds that do not comply with the laws, then $p$ is false in the worlds that do comply with the laws.

\[(34) \forall w' \in \text{Neg-O}_i(M) \ p(w') \rightarrow \forall w'' \in O_i(M_i) \neg p(w'') \]

We claim that expletive-$ne$ it is the overt spell out of the silent negation operating over the modal base and encoded in the meaning of the verb (thus rendering justice to an intuition that underlies all accounts of expletive negation), and lack of apparent proper semantic contribution follows from this redundancy. Positive and negative priority attitudes thus convey the same meaning, but encode it in a different manner, which explains why with the latter only the negation is expletive.

Summing up, our account defends an analysis based on ambiguity in the interpretation of $ne$. In Latin $ne$ acts as a true negation in the context of imperatives and positive priority attitudes and, in this case, it is prohibitive; it is a negation operating over the ordering source with negative priority modals, and, in this case, it is expletive. This difference is driven by the lexical meaning of negative priority attitudes that encode a component of ‘contrariness’ and that the
expletive negation makes visible. There is thus a type difference between the two ne: expletive 
ne operates over a set of propositions, whereas prohibitive ne operates over a proposition. We 
will now see that this view makes important predictions.

4.1. Predictions

Prediction: the distributions of \( \text{NEG}_2 \) .... \( \text{NEG}_1 \)  Our first prediction is that negative priority 
attitudes such as \textit{prohibere} and \textit{timere} can embed \( \text{ne} \ldots \text{non} \). This fact is observable in Latin, 
Albanian and Greek. In this case, the expletive \( \text{ne} \) is interpreted as a modifier of the ordering 
source and \( \text{non} \) is interpreted at the level of the proposition.

\[(35)\] Sed \textit{timeo} \text{ne} \text{non} \text{ impetrem.} 
\begin{align*}
\text{But fear.1SG NEG}_2 \text{NEG}_1 \text{ achieve.1SG.SUBJ} \\
\text{‘But I fear that I may not obtain it. (Cic, Att, 9)}
\end{align*}

\[(36)\] \text{Timeo ne-non.} 
\[
\forall w' \in \text{Neg-DEON}_i(Dox_i) \neg p(w')
\]

\[
\begin{array}{c}
\text{FORBID/FEAR} \\
\lambda M \lambda O \lambda p \\
[\forall w' \in O(M) p(w')] \\
\text{Neg-DEON}_i \\
\text{ne} \text{ DEON}_i
\end{array}
\]

\[
\text{DOX}_i
\]

\text{NegP}

Second prediction: only TP \( \text{ne} \) undergoes the Jespersen cycle  Our analysis allows to ex-
plain the facts pertaining to the evolution of negation from Latin to French, and in particular the 
observation that only \( \text{ne} \) in the context of imperatives and positive priority attitudes undergoes 
the Jespersen cycle. The Jespersen cycle is the diachronic process whereby the solitary nega-
tion marker \( \text{ne} \) becomes gradually doubled with the negative adverb \( \text{pas} \). In Modern French 
negative imperatives and negative orders conveyed by the combination of a positive priority 
attitudes and an embedded negation, use \( \text{ne} \ldots \text{pas} \).

\[(37)\] \textbf{Ne viens pas !} 
\begin{align*}
\text{NEG come.2SG.IMP not} \\
\text{‘Don’t come!’}
\end{align*}

\[(38)\] J’ordonne que tu \textbf{ne viennes pas}. 
\begin{align*}
\text{I order that you NEG come.2SG.SUBJ not} \\
\text{‘I order you not to come.’}
\end{align*}

We have proposed that the negation in the context of negative priority attitudes does not bear 
propositional negative meaning. Since it is not recognized as a proper negative element, it does 
not undergo the Jespersen Cycle. Solitary \( \text{ne} \) is still found with negative priority attitudes in 
Modern French and indeed strives in a new variety of contexts. Mari and Tahar (2020) show
that, once the Jespersen Cycle is completed in French, expletive negation strives as ‘freed’ by the end of the competition with the homonymous propositional negation.

Having established that negative priorities (technically, negative ordering sources) are the key element triggering expletive negation in modern French, explaining how the reversing of the ordering happens in before, without-clauses, unless-clauses and comparatives is a matter that we leave for future research. We note, however, that the common to the exceptives and before clauses is a contrariness relation between the two propositions that these connectors relate (see Mari and Tahar (2020) for further discussion).

5. Extension to negative doxastics

In French, ne receives a nonnegative reading in the embedded clause of verbs of doubt and denial, see (39), (40):

(39)  a. Si [les terres] pouvaient, mieux cultivées, rapporter plus, je doute que le
    If the land could, better cultivated, bring more, I doubt that the
    fermier ne s’ y attelle.
    farmer *ne REFL.3SG it undertake3SG.SUBJ
    ‘If the land could, if better cultivated, yield more, I doubt that the farmer would
    undertake it.’ (André Gide, L’immoraliste, 1902)

b. Je ne *doute pas qu’ il ne nous arrive malheur.
    I do not doubt that it *ne CL happen.3SG.SUBJ misfortune.
    ‘I have no doubt that something bad will happen to us.’
    (Stendhal, La Chartreuse de Parme, 1839)

(40)  a. Et je niai que le garçon aux pieds agiles n’ eût eu d’
    And I denied that the boy of feet agile ne have.3SG.PAST.SUBJ the
    yeux que pour elle.
    eyes only for her
    ‘And I denied that the boy with agile feet had only had eyes for her.’
    (Proust, A la recherche du temps perdu, 1922)

b. Ils ne nient pas qu’ il n’ y ait un Dieu
    they NEG deny.2SG.FUT not that PRO-3SG ne CL have.3SG.SUBJ a God
    supérieur.
    superior.
    ‘They do not deny that there is a superior God.’
    (Maurice Barrès, Mes Cahiers, 1914)

The diachronic origin of ne under doubt verbs is different from the origin of expletive ne with imperative and priority attitudes. Indeed, the expletive negation found with epistemic attitudes originates from quin, resulting from the fusion of the interrogative adverb qui (how/why) with the enclitic negation -ne (see Fleck (2008)). However, we believe that it is possible to provide a unified semantics for expletive negation across priority and epistemic attitudes by extending the analysis we made for priority attitudes of the FORBID or FEAR-type to negatively-biased epistemic attitudes of the DOUBT-type. At the semantic level, we claim, these epistemic attitudes convey a meaning of contrariness. The starting point of our analysis is Mari’s (2016) proposal for belief predicates Mari (2016). To explain the fact that belief attitudes can licence subjunc-
tive across languages, Mari proposes that belief predicates feature an epistemic modal base (which is partitioned, indicating lack of knowledge) and a doxastic ordering source. By quantifying over worlds that comply with the ordering source, the attitude conveys that in worlds that best comply with the attitude holder’s opinions, \( p \) is true, although she does not know whether \( p \) is true.

\[
\forall w' \in \text{DOX}_i(\text{Epis}_i) \quad p(w')
\]

\[
\text{BELIEVE} \quad \text{DOX}_i \\
\lambda M \lambda O \lambda p \\
[\forall w' \in O(M) \quad p(w')]
\]

We now propose that doubt (a subjunctive selector cross-linguistically, see also Anand and Hacquard (2013) for the idea that doubt features a preferential component) encodes dispreferred belief, expressing that \( p \) is true in worlds that do not comply with what the speaker believes. In other terms, doubt is a negatively-biased epistemic attitude, akin to forbid in the realm of commands.

\[
\forall w' \in \text{Neg-DOX}_i(\text{Epis}_i) \quad p(w')
\]

\[
\text{DOUBT} \quad \text{Neg-DOX}_i \\
\lambda M \lambda O \lambda p \\
[\forall w' \in O(M) \quad p(w')]
\]

One possible objection to our analysis is that the expletive \( ne \) is also found under \( ne \text{ pas douter} \), which means ‘be certain’ and can be argued not to feature an ordering source.

\[
\text{Je ne doute pas qu'elle ne vienne à la fête.}
\]

I NEG doubt not that-she \( ne \) come.3SG.SUBJ to the party.

‘I have no doubt that she will come to the party.’

We argue that the main clause negation is metalinguistic: ‘I do not doubt that \( p \)’ amounts to ‘It is not true that I doubt that \( p \)’. According to well-established accounts of negatively-biased verbs, and negative expressions more generally, the higher negation is justified when the possibility that the speaker is ‘doubting that \( p \)’ is active in the conversation (Ducrot (1985)).

Few occurrences of expletive negations are also found with negated negative modals (impossible, unlikely), as expected by the analysis.

\[9\]For extended discussion on how this proposal connects with the standard Hintikkean semantics for belief, see Giannakidou and Mari (2021) and Mari and Portner (2018).
The same analysis extends to DENY type of verbs. The ordering source is the set of propositions that are the content of the attitude anchor’s saying and orders worlds in the common ground according to those that best comply with the saying. Denying worlds would introduce contrariness by the same mechanism as above, by ordering as higher those worlds that worst comply with the attitude anchor’s saying, see Mari and Portner (2018).

\[ \forall w' \in \text{Neg-SAY}_i(CG) \ p(w') \]

6. Conclusion

To conclude, these diverse origins of expletive *ne* (s) (from prohibitive negation or from an interrogative negation), and its distributions with imperatives and command attitudes on the one hand (for the expletive *ne* originating from *mē*) and with biased questions and epistemic attitudes on the other (for expletive *ne* originating from *quin*) points to a deep relation between types of attitudes (priority attitudes and epistemic attitudes) and speech acts types (imperatives and questions). We have tried to spell out these relations in terms of modal meaning on the basis of the diachronic evolution of expletive negation from Latin to Modern French. Whether our suggestions of such a unified analysis for attitudes and speech acts is on the right track still remains an open question which would benefit from further diachronic work. Focusing on French and its history from Latin, we hope that we offered a caveat to reconsider the nature of expletive negation as contributing new evidence to further establish a connection between attitudes, modality and speech acts (see Portner (2018) for the most recent discussion on these connections).

References


Decomposing distributive numerals in ʔayʔaǰuθəm (Comox-Sliammon Salish)

Gloria MELLESMOEN — University of British Columbia
Henry DAVIS — University of British Columbia
Lisa MATTHEWSON — University of British Columbia

Abstract. In this paper we examine distributive numerals in ʔayʔaǰuθəm (a.k.a. Comox-Sliammon; Central Salish). We first show that unlike in neighbouring St’át’imcets (Northern Interior Salish), ʔayʔaǰuθəm distributive numerals require specifically temporal distribution over sub-events, as opposed to over locations or event participants. We then provide a compositional analysis of the three morphological components of distributive numerals: the numeral itself; diminutive reduplication, which excludes alternatives in the denotation of the numeral; and a pluractional infix, which when applied to a numeral and a predicate of events yields temporally distributed sub-events, where the number of participants in each sub-event is given by the numeral. Finally, we point out that though our account handles core cases of distributed numerals, their syntactic distribution is extremely broad, mirroring precisely that of bare numerals: this causes non-trivial problems for compositionality.

Keywords: distributivity, pluractionality, numerals, Salish.

1. Introduction

In this paper we examine distributive numerals in ʔayʔaǰuθəm (a.k.a. Comox-Sliammon; Central Salish, ISO 363-3 coo). ʔayʔaǰuθəm is traditionally spoken in south coastal British Columbia by the Tla’amin, K’ómoks, Homalco, and Klahoose First Nations; it is highly endangered, with an estimated 47 remaining first language speakers as of 2018 (FPCC, 2018). The ʔayʔaǰuθəm data presented in this paper come from original fieldwork with 10 speakers. Building on previous work by Matthewson (2000) on the neighbouring Northern Interior Salish language St’át’imcets (a.k.a. Lillooet, ISO 363-3 lil), we first show that distributive numerals in ʔayʔaǰuθəm specifically require temporal distribution over sub-events, as opposed to distribution over locations or individuals. We then show that unlike other distributive numerals discussed in the literature, the ones in ʔayʔaǰuθəm are transparently composed of three morphemes: a numeral root, diminutive reduplication, and a pluractional infix. We provide a compositional analysis based on these three morphemes, observing however that the extreme ‘syntactic promiscuity’ of the ʔayʔaǰuθəm distributive numerals – their ability to appear in at least six different surface syntactic environments – raises significant challenges for the syntax-
Distributive numerals enforce a distributive plural interpretation of the predicates with which they are associated. They are often ambiguous between participant-related and event-related interpretations, allowing for distributivity over either individuals or events. A representative example from Tlingit (Na-Dene) is given in (1), from Cable (2014). The plain numeral in (1a) favours collective or cumulative readings, but the distributive numeral in (1b) enforces a distributive reading, either over individuals or over events.\(^2\)

(1)  

Tlingit:

\[
\begin{align*}
\text{a. } & \text{Nás'k } \text{xáat } \text{has aawasháat.} \\
& \text{three } \text{fish } \text{PL.3O.PFV.3S.catch} \\
& \text{‘They caught three fish.’}
\end{align*}
\]

\[
\begin{align*}
\text{b. } & \text{Nás’gigáa } \text{xáat } \text{has aawasháat.} \\
& \text{three.DIST } \text{fish } \text{PL.3O.PFV.3O.catch} \\
& \text{‘They caught three fish each.’} \\
& \text{‘They caught three fish each time.’} \quad \text{(Cable, 2014:564)}
\end{align*}
\]

There is cross-linguistic variation in the interpretation of distributive numerals. For example, the distributive numeral \textit{pəlpálaʔ~pipálaʔ} ‘one by one’ in St’át’imcets allows temporal or spatial distribution over events, but not distribution over individuals.\(^3\) The example in (2) shows ambiguity between temporal and spatial readings.

(2)  

St’át’imcets:

\[
\begin{align*}
\text{pipáplaʔ } & \text{l=as } \text{xʷík-əm } \text{ʔi=ʔuxʷalmíxʷ=a} \\
& \text{HUM.DIST COMP=IPFV+3CJV} \\
& \text{cut.fish-MID PL.DET=person=EXIS} \\
& \text{l=ta=sísxəc=a}^5 \\
& \text{on=DET=shore=EXIS}
\end{align*}
\]

\(^2\) Such challenges are a hallmark of distributive numerals cross-linguistically; see Gil (1982), Choe (1987), Farkas (1997), Zimmermann (2002), Henderson (2011), Cable (2014), among others. \textit{ʔayʔaǰuθəm} is a particularly challenging case, as we show in Section 4.

\(^3\) The transcription (and glossing) from Cable (2014) are unchanged, while examples from St’át’imcets and \textit{ʔayʔaǰuθəm} are given in North American Phonetic Alphabet (NAPA) notation. Primary stress in St’át’imcets is marked with an accent, but in \textit{ʔayʔaǰuθəm} it falls predictably on the first syllable, and is therefore not marked. Labels outside of the standard Leipzig glossing conventions include: 3O = third-person object, 3S = third-person subject, CJV = ‘conjunctive’ (the Salishanist term for subjunctive), CTR = control transitive, DIM = diminutive, DIR = directive (control) transitivizer, DIST = distributive, EXIS = existential, HUM = human, MID = middle, NTR = non-control transitive, NTS = non-topic subject, and STAT = stative. Note that DIST is used here, as in Cable (2014) and Matthewson (2000), to mean ‘distributive’ rather than ‘distal’.

\(^4\) \textit{pəlpálaʔ} and \textit{pipálaʔ} are dialectal variants, with no meaning difference.

\(^5\) \textit{pipáplaʔ} is a form of \textit{pipálaʔ} optionally used when counting humans. Note that though distributive numerals in St’át’imcets are derived from bare numerals by reduplication, they are largely opaque in terms of morphological composition, unlike in \textit{ʔayʔaǰuθəm}. 
(i) ‘People are cutting fish one by one.’ (e.g., if taking turns at the same fish rack)
(ii) ‘People are cutting fish here and there.’ (e.g., if fish racks are scattered along the shore)

The absence of a participant-distributive reading for pəlpálaʔ~pipálaʔ is illustrated in (3)-(4). (3) shows that the distributive numeral does not require each individual to participate in an event of table-lifting, while (4) shows that it does require each sub-event of table-lifting to contain only one individual.

(3) St’át’imcets:
Context: There were four women trying to lift a table. Victoria lifted it by herself, Anne lifted it by herself, and Mary and Elizabeth didn’t manage.

$pəlpálaʔʔi=sməɬmúɬac=a_xat-aŋ-táli_ta=tïpəł=a$

‘The women lifted the table one at a time.’ (Matthewson, 2000:101)

(4) St’át’imcets:
Context: There were four women. Victoria lifted the table by herself, Anne lifted it by herself, and Mary and Elizabeth lifted it together.

# $pəlpálaʔʔi=sməɬmúɬac=a_xat-aŋ-táli_ta=tïpəł=a$

‘The women lifted the table one at a time.’ (Matthewson, 2000:105)

As we will now show, the cognate form (paʔapaʔaʔ) in ʔayʔaǰuθəm is even more restricted, allowing neither distribution over participants nor over locations, but only over times.

2. The interpretation of distributive numerals in ʔayʔaǰuθəm

Distributive numerals in ʔayʔaǰuθəm do not universally quantify over individuals, as shown in (5)-(6). Although not every egg is broken or pair of cookies is eaten, the sentences are felicitous.

(5) Context: A recipe calls for four eggs, but I have 12.

$p<\text{a}\rangle a<\text{p}\rangle ya\rangle$ $[\text{təqʷ-t-an}_\text{DET} \chi^*aχ^*it]$

‘I broke the eggs one at a time.’

Proclitics, including determiners and the clausal nominalizer $s$, are more often than not phonologically elided in ʔayʔaǰuθəm, though they can be restored in careful speech. The presence of the nominalizer can also sometimes (but not always) be inferred from possessive subject marking on a nominalized clause. We mark the presence of elided elements by [...] in the gloss line: e.g., [DET] [NMLZ]. Note also that nominalized complement clauses are introduced by elements that are formally indistinguishable from determiners (though not all determiners introduce
(6) Context: Bruno ate cookies stacked two on top of each other, but some are left on the plate.

\[ \text{s aer a ya} \quad [\text{məmkʷ-t-as}] \]
\[ \text{two PL DIM} \quad [\text{IPFV-eat-CTR-3ERG}] \]

‘He is eating them two at a time.’

The felicitous use of a distributive numeral requires exhaustive distribution over sub-events, such that in each sub-event, the number of participants is given by the numeral. In (7), the requirement imposed by the numeral ‘one’ is that each cracking sub-event contain only one egg. Since two eggs are cracked together, the sentence is infelicitous. And as we just saw in (6), the distributive numeral ‘two’ requires two individuals (in this case, cookies) to be involved in each sub-event.

(7) Context: A recipe calls for four eggs and I crack one egg, then another, before cracking the last two together.

\# \[ \text{p aer a ya} \quad [\text{iəqʷ-t-an} \quad \text{χʷəχʷit}] \]
\[ \text{one PL DIM} \quad [\text{DET, crack-CTR-1SG.ERG} \quad [\text{DET, egg}]] \]

‘I broke the eggs one at a time.’

The sentence in (8) shows that ʔayʔaǰuθəm distributive numerals further entail that there is no temporal overlap between sub-events. The locking events must occur one after the other, not all at once, in order for the sentence to be felicitous.

(8) \[ \text{p aer a ya} \quad [\text{ləkli-t-as} \quad ?əm~ʔimin] \]
\[ \text{one PL DIM} \quad [\text{DET, lock-CTR-3ERG} \quad [\text{DET, PL~door}]] \]

‘She locked the doors one by one.’

Ok in context: I went around and manually locked doors on the car.
Ok in context: I work at a dealership and I press buttons sequentially to lock each car.
# in context: I pressed a button and all the doors locked simultaneously on my car.

In summary so far, ʔayʔaǰuθəm distributive numerals enforce distribution over sub-events, such that no sub-events overlap temporally, and each sub-event involves (possibly plural) participants whose cardinality is given by the numeral.

3. The decomposition of distributive numerals

In this section, we provide a step-by-step account of how the three morphological components of distributive numerals (a numeral root, diminutive reduplication, and reduplicative pluractional infix) combine in that order, and the semantics we need at each stage. The
morphological decomposition of the distributive numerals ‘one by one’ and ‘two by two’ is illustrated in (9) and (10), respectively.\(^7\)

\[(9)\]
\[
\begin{array}{llll}
\text{a. } & \sqrt{\text{paʔa}} & \text{b. } & \text{pa}<\text{p}>\text{yaʔ} \\
\text{one} & \text{c. } & \text{p}<\text{aʔ}>\text{a}<\text{p}>\text{yaʔ} & \text{one}<\text{DIM}> \\
\text{‘one’} & & \text{‘just/only one’} & \text{‘one by one’} \\
\end{array}
\]

\[(10)\]
\[
\begin{array}{llll}
\text{a. } & \sqrt{\text{saʔa}} & \text{b. } & \text{sa}<\text{s}>\text{yaʔ} \\
\text{two} & \text{c. } & \text{s}<\text{aʔ}>\text{a}<\text{s}>\text{yaʔ} & \text{two}<\text{DIM}> \\
\text{‘two’} & & \text{‘just/only two’} & \text{‘two by two’} \\
\end{array}
\]

We begin with the numeral root, which can surface in unmodified form as a bare (simplex) numeral.

3.1. Bare numerals

Bare numerals in ʔayʔaǰuθəm, as in other Salish languages, have the status of cardinality predicates rather than determiners (see Jelinek, 1995; Matthewson, 1998). They may count either individuals or events, as shown in (11) and (12) respectively. Note that the numeral in these examples is in the clause-initial main predicate position, with the individual or event argument represented by the following DP (with an elided determiner).\(^8\)

\[(11)\]
\[
\text{saʔa } [ \text{ mimaw} ] \\
\text{two } [ [\text{DET}] \text{ cat } ] \\
\text{‘There are two cats.’} \\
\text{Literally: ‘The cats are two.’}
\]

\[(12)\]
\[
\text{čaləs } [ \text{ kʷit̓ᶿ-əm=}s \text{ Gloria} ] \\
\text{three } [ [\text{DET}][\text{NMLZ}] \text{ jump-MID=}3\text{POSS} \text{ Gloria} ] \\
\text{‘Gloria jumped three times.’} \\
\text{Literally: ‘Gloria’s jumpings were three.’}
\]

As in English, ʔayʔaǰuθəm bare numerals are compatible with ‘at least’ interpretations, in addition to an ‘exactly’ interpretation. This is illustrated in (13)-(14).

\[(13)\]
\[
\text{Context: If Gloria wakes up more than twice, she will go for a walk before going back to bed. Last night, she woke up three times. Someone asks why she went for a walk at 4a.m.} \\
\text{saʔa } [ \text{ p<š>i<š>č-əm} ] \\
\text{two } [ [\text{DET}][\text{NMLZ}] \text{ wake<PL><DIM>-MID} ]
\]

\(7\) There are additional (regular) morpho-phonological changes involved here; see Mellesmoen (in press).

\(8\) Event-counting as opposed to entity-counting with numerals and other cardinality predicates requires a nominalized subordinate clause, as shown in the contrast between (11) and (12). We assume here that nominalization is necessary to trigger lambda abstraction over an event argument, whereas no such operation is required for entities.
‘She woke up twice.’
Literally: ‘Her waking ups were two.’

(14) saʔa čayiš [two hand] [DET 1SG.POSS [NMLZ] measure-CTR-PST]
‘I measured it as two hands (long).’

Following Krifka (1999), we model the ‘at least’ interpretation of bare numerals by including alternatives to the ordinary semantic value (which has an ‘exactly’ interpretation) in the denotations. For example, the ordinary semantic value of the bare numeral saʔa ‘two’ gives the interpretation ‘exactly two’ (15a), and the alternative semantic value in addition allows an ‘at least two’ reading (15b).9 The default for an assertion is that the alternatives are understood not to be asserted; this gives rise to the usual scalar implicature effects (see Krifka, 1999 for details).

(15) a. ⟦saʔa⟧ = λx . 2(x) ‘the number of atoms in the sum individual x is 2’
b. ⟦saʔa⟧A = {λx . n(x) | n ∈ N & n ≥ 2} (adapted from Krifka, 1999)

The denotations in (15) account for the use of numerals when they take individual arguments, as in (11). For numerals which take clausal arguments, we need to also allow the numerals to be predicates of events (of type <l,t>), as in (16).

(16) a. ⟦saʔa⟧ = λe . 2(e)
b. ⟦saʔa⟧A = {λe . n(e) | n ∈ N & n ≥ 2}

Using these lexical entries, we provide denotations in (17) and (18) for the ordinary semantic value of the sentences in (11) and (13), respectively. For current purposes, we assume a choice function analysis of ʔayʔaǰuθəm determiners, whereby they pick a contextually salient (possibly plural) individual from a set (cf. Matthewson, 1999, 2001; Davis, 2010 for Stát’imcets).10

(17) ⟦saʔa DET; mimaw⟧ = [λx . 2(x)] (g(i)({y | y is a cat}))
= 1 iff 2(g(i)({y . y is a cat}))
‘The number of atoms in the individual chosen from the set of cats by the choice function g(i) is 2’ ≈ ‘There are two salient cats.’

(18) ⟦saʔa DET; piʔipčəm⟧ = [λe . 2(e)] (g(i)({e’ | e’ is an event of her waking up}))
= 1 iff 2(g(i)({e’ | e’ is an event of her waking up}))
‘The number of atoms in the individual chosen from the set of events of her waking up by the choice function g(i) is 2’ ≈ ‘There are two salient events of her waking up.’

9 Krifka (1999) allows ‘at most’ readings for numerals as well. This seems to be the case also in ʔayʔaǰuθəm, although they are less common (as they are in English) and we set them aside here.
10 We are taking the liberty of speaking sloppily about the difference between sets and plural individuals throughout this paper.
3.2. Diminutive reduplication

Diminutive (-C₁-) reduplication infixes a copy of the first consonant of the root after the initial vowel. It applies to roots of any lexical category, and, as its name implies, usually yields a meaning of ‘small size, amount, or reduced force’, depending on the root class to which it attaches (Watanabe, 2003:385).

(19) tə<ti>q-əm
    dip<DIM>−MID
    ‘dripping a little bit/from one place/slowly’

(20) ti<ti>q-it
    close<DIM>−STAT
    ‘a little bit closed’

(21) ta<ti>l-awus-tən
    money<DIM>−eye−instrument
    ‘child-size eyeglasses’

With numerals, however, diminutive reduplication yields a special meaning of ‘exactly n’ (Watanabe, 2003:502), as shown in (22)-(23). The bare numeral in (23a) (originally given as (13)) is fine with the ‘at least’ reading required by this context, but the diminutive numeral in (23b) is rejected. (Note that (23b) is felicitous in a context in which Gloria did wake up exactly twice.)

(22) sa<s>yaʔ [ mimaw]
    two<DIM> [[DET] cat]
    ‘There are just two cats.’

(23) Context: If Gloria wakes up more than twice, she will go for a walk before going back to bed. Last night, she woke up three times. Someone asks why she went for a walk at 4 a.m.

   a. saʔa [ p<iʔ>i<p>č-əm]
      two [[DET] [NMLZ] wake<PL><DIM>−MID]
      ‘She woke up twice.’

   b. # sa<s>yaʔ [ p<iʔ>i<p>č-əm]
      two [[DET] [NMLZ] wake<PL><DIM>−MID]
      ‘She woke up (just) twice.’

We model the semantic effect of the diminutive, when it applies to a numeral, as the elimination of the alternatives present in the denotation of the bare numeral (see (15)): when a numeral undergoes diminutive reduplication, only the ordinary (‘exact’) value is possible. The lexical entry for diminutive reduplication as applied to numerals is given in (24): it returns the ordinary
semantic value of the numeral, minus its alternatives, as shown in (25) for application to saʔa ‘two’.

(24) ⟦ - C₁-[NUM] (P) ⟧ is defined iff P is a numeral predicate.
    If defined, ⟦ - C₁-[NUM] (P) ⟧ = \( \lambda x . P(x) \) & \( \neg \exists Q \ [Q \neq P \& Q \in P_\Lambda \& Q(x)] \)

(25) ⟦ sa<s>yaʔ ⟧ = \( \lambda x . 2(x) \) & \( \neg \exists Q \ [Q \neq \lambda x . 2(x) \& Q \in \{ \lambda y . n(y) \mid n \in N \& n \geq 2 \} \& Q(x)] \)

Using this lexical entry for the diminutive, the denotation of the sentence in (22) is given in (26).

(26) ⟦ sa<s>yaʔ DET; mimaw ⟧ = 1 iff \( 2(g(i)(\{ y . y \text{ is a cat} \})) \) & \( \neg \exists Q \ [Q \neq \lambda x . 2(x) \& Q \in \{ \lambda y . n(y) \mid n \in N \& n \geq 2 \} \& Q(g(i)(\{ y . y \text{ is a cat} \}))] \)

‘The number of atoms in the sum individual chosen from the set of cats by the choice function \( g(i) \) is 2 and there are no alternative numerals greater than 2 which are the number of atoms in that sum individual’ ≈ ‘There are exactly two salient cats.’

3.3. The pluractional infix (-V₁-)

The -V₁- pluractional infix attaches to verbs to yield temporally distributed event repetition, as shown in (27). It usually co-occurs with diminutive reduplication, leading Watanabe (2003:403) to treat the two processes as components of a single complex CVʔV- reduplication process. Since diminutive (-C₁-) reduplication can occur on its own, however, we isolate the pluractional component as the contribution of the -V₁- infix (see Mellesmoen, in press for argumentation, and Blake, 2000 for a similar description of a plural infix distinct from diminutive reduplication).

(27) \( \lambda^{<aʔ}>a<ƛ̓>k̓w \) [ nikʷayu]
    turn.off<PL><DIM>  [[DET] light]

‘The lights are flickering on and off.’

The denotation for the pluractional infix when it applies to verbs is given in (28). It applies to a predicate \( P \), and outputs a relation between individuals \( x \) and events \( e \), such that \( e \) is made up of a set of sub-events \( e_n \), and for each of these sub-events \( e_n \), there is an individual \( z \) which is part of \( x \) and \( e_n \) is an event of \( P \) applying to \( z \), and no two sub-events of \( e \) overlap temporally.

(28) ⟦ -V₁- ⟧ = \( \lambda P_{<e_i,lt>} \lambda x \lambda e . [\exists e_1 ... \exists e_n \ [e = e_1 + ... + e_n \& \forall e_n[[e_n < e] \rightarrow \exists z [z \leq x \& P(z)(e_n)] \& \forall e_n,e_m[[e_n,e_m < e] \rightarrow \neg[\tau (e_n) \circ \tau (e_m)]]] \)

This denotation is applied to the sentence in (27) in (29). The sentence is true if and only if there is an event \( e \) with sub-events \( e_1 ... e_n \) and for each of these sub-events \( e_n \), there is an

11 It would be desirable to provide a unified lexical entry for diminutive reduplication that yields appropriate meanings for each lexical class which it applies to. That task is beyond the scope of this paper, however.
individual \(z\) which is part of the set of salient lights, and \(e_n\) is an event of \(z\) turning off, and no two sub-events of \(e\) overlap temporally.

\[(29) \quad \lambda \eta \eta \lambda z [\eta \in \text{salient} \land \exists e \exists e_1 ... \exists e_n [e = e_1 + ... + e_n \land \forall e_n [e_n < e] \rightarrow \exists z \leq (g(i)( \{v \mid v \text{ is a light} \}) \land e_n \text{ is an event of } z \text{ turning off} \land \forall e_n, e_m [e_n,e_m < e] \rightarrow \neg[\tau(e_n) \circ \tau(e_m)]]] \]

This plurational infix can also appear inside numerals, as we have seen. When it does so (along with diminutive reduplication), it yields temporally distributed sub-events, where the number of participants in each sub-event is given by the numeral.\(^{12}\) An example is given in (30).

\[(30) \quad s \lambda a \lambda s \lambda ya \lambda [pəč-əm tə məm~mimaw] \quad \text{two}<\text{PL}><\text{DIM}> \quad \text{wake-MID DET PL~cat}
\]

‘The cats woke up two by two.’

Literally: ‘The waking ups by cats were two by two.’

Compare these cases to those of simplex numerals in predicate position (e.g. (12) and (13)), which take plural events as arguments and count the number of their sub-events (see the denotation in (18)). Notice in particular that it is only plurationalized numerals which constrain the number of participants in each sub-event.

In order to model the special behavior of the plurational infix on (diminutive) numerals, we give it a second lexical entry, shown in (31). (This parallels the fact that the diminutive marker also has a specific effect when adding to numerals; see (24) above.) A distributed numeral, created by infixation of the plurational marker into a numeral predicate \(P\), takes a predicate of events \(R\) and yields a set of events, each of whose sub-events is mapped onto an event-participant \(z\), and the number of atoms in each participant \(z\) is given by the numeral.\(^{13}\)

\[(31) \quad \lambda e \lambda R \lambda \lambda z \lambda e_1 ... \lambda e_n [e = e_1 + ... + e_n \land \forall e_n [e_n < e] \rightarrow \exists z \land \text{PARTICIPANT}(z)(e_n) \land R(e_n) \land \text{P}(z)] \land \forall e_n, e_m [e_n,e_m < e] \rightarrow \neg[\tau(e_n) \circ \tau(e_m)]]] \]

The denotation for (30) we derive by employing (31) is given in (32). This says that there is an event \(e\) which is made up of sub-events \(e_1 ... e_n\) and for each of these sub-events \(e_n\) there is a participant \(z\) in \(e_n\) which has two atoms, and \(e_n\) is an event of salient cats waking up and no sub-events overlap temporally.

\[(32) \quad \lambda e \lambda e_1 ... \lambda e_n [e = e_1 + ... + e_n \land \forall e_n [e_n < e] \rightarrow \exists z \land \text{PARTICIPANT}(z)(e_n) \land \text{wake.up}((g(i)( \{y \mid y \text{ is a cat} \}))(e_n) \land 2(z) \land \forall e_n, e_m [e_n,e_m < e] \rightarrow \neg[\tau(e_n) \circ \tau(e_m)]]] \]

\(^{12}\) The plurational infix is not attested with numbers independently of diminutive reduplication.

\(^{13}\) In order to simplify the calculation, we treat the (elided) determiner which introduces the predicate of events as semantically vacuous here. As for why we introduce a PARTICIPANT operator, cf. Cable (2014) and see Section 4.2 below.
**4. Challenges for compositionality**

The analysis given immediately above successfully handles cases in which a distributive numeral applies to a predicate of events, including most of the examples we have seen so far. However, this does not exhaust the range of syntactic contexts in which distributed numerals occur: in fact, far from it, since in ʔayʔaǰuθəm distributive numerals display pervasive syntactic flexibility. Furthermore, this flexibility is shared by *all* numeral predicates, including simplex ones; and importantly, the semantic effect of each type of numeral (including both distributive and simplex cases) is identical regardless of where they occur.\(^\text{14}\)

These facts pose some serious challenges for a compositional analysis. In this section, we will first outline the range of environments in which both simplex and distributed numerals occur (4.1), and then address the two most salient sets of problems, which we will refer to as the ‘missing argument problem’ (4.2) and the ‘argument ordering problem’ (4.3). Though we cannot claim to have solved either of them, we do have some ideas as to why they might have arisen, which we discuss in 4.4.

### 4.1 The syntactic distribution of (distributive) numerals

Both bare and distributive numerals occur as main predicates, as we have seen. However, the range of syntactic arguments which they take is considerably broader than the cases we have analyzed so far, which involve a nominalized complement clause acting semantically as a predicate of events, as further illustrated in (33). The other cases involve DP arguments, including headed relative clauses, as in (34), headless (or *pro*-headed) relative clauses, as in (35), and simple (non-clausal) DPs, as in (36).

\[(33)\] a. \[\text{paʔa} [kʷ puh-ut=s \text{candle}]\]
\[\text{one} [\text{DET [NMLZ] blow-CTR=3POSS candle}]\]

‘She blew out one candle.’

Literally: ‘It was one (time) that she blew out the candle.’

b. \[\text{p<aʔ>ʔa}<\text{<p>yaʔ} [tə nap-at=s nəgapti]\]
\[\text{one}<\text{PL}<\text{<DIM> [DET [NMLZ] lecture-CTR=3POSS women}]\]

‘He lectures the women, one at a time.’

Literally: ‘It is one at a time that he lectures the women.’ (Mellesmoen, in press)

\[(34)\] a. \[\text{paʔa} [tə walθ qʷum-qi(n)-t-as-ul Ophelia]\]
\[\text{one} [\text{DET frog put.in.mouth-inside.of.mouth-3ERG-PST Ophelia}]\]

‘Ophelia kissed one frog.’

Literally: ‘The frog Ophelia kissed was one.’

---

\(^{14}\) Diminutive numerals which lack the pluractional infix (such as *papyəʔ*) also share the same positional variability and invariant interpretation.

\(^{15}\) The /n/ in the suffix -qin ‘inside of mouth’ is systematically deleted before /t/.
b. p<\(a?\)>a<\(p\)>yaʔ [tə cars kʷə~kʷt-igən]
   one<\(PL\)><\(DIM\)> [DET cars IPFV~pass.by-side.of.body]
   ‘One by one, they (the cars) passed by.’
   Literally: ‘The cars that passed by were one by one.’ (Mellesmoen, in press)

(35) a. paʔa [tə qʷum-qi(n)-t-as-uɬ Ophelia]
   one [DET put.in.mouth-inside.of.mouth-CTR-3ERG-PST Ophelia]
   ‘Ophelia kissed one.’
   Literally: ‘The one Ophelia kissed was one.’

b. p<\(a?\)>a<\(p\)>yaʔ [tə kʷa~kʷ<a>t-igən]
   one<\(PL\)><\(DIM\)> [DET IPFV~pass.by<\(PL\>>-side.of.body]
   ‘One by one, they (the cars) passed by.’
   Literally: ‘The ones that passed by were one by one.’ (Mellesmoen, in press)

(36) a. paʔa [tə kʷasta]
   one [DET cup]
   ‘There is one cup.’
   Literally: ‘The cup is one.’

b. p<\(a?\)>a<\(p\)>yaʔ [tə kʷastə]
   one<\(PL\)><\(DIM\)> [DET cup]
   ‘(Hand me) the cups, one by one.’ (Mellesmoen, in press)
   Literally: ‘One by one the cups.’

Both bare and distributive numerals may also occur as both predicate and argument modifiers. As predicate modifiers, they form a constituent with a nominal in predicate position, as in (37) (see Davis et al., 1997).

(37) a. [paʔa bagel] [tə čəw-ul]
   [one bagel] [DET steal-PST]
   ‘She stole one bagel.’
   Literally: ‘The one she stole was one bagel.’

b. [p<\(a?\)>a<\(p\)>yaʔ bagels] [tə čəw-ul]
   [one<\(PL\)><\(DIM\)> bagels] [DET steal-PST]
   ‘She stole the bagels, one at a time.’
   Literally: ‘The ones she stole were one by one bagels.’ (Mellesmoen, in press)

As argument modifiers, numerals occur in DP in both pre-determiner (38) and post-determiner (39) positions.

(38) a. xʷət-əxʷ-an [paʔa [tə laplaš]]
   drop-NTR-1SG.ERG [one [DET board]]
   ‘I dropped one board.’
Decomposing distributive numerals in ?ayʔajuθəm (Comox-Sliammon Salish)

b. nam-at-as-ul  [p<aʔ>a<p>yaʔ  [tə  pipa]]
   write-CTR-3ERG-PST  [one<PL><DIM>  [DET  paper]]
   ‘She wrote the papers, one at a time.’  (Mellesmoen, in press)
   Literally: ‘She wrote the one by one papers.’

(39) a. xʷət ̓m-əxʷ-an  [tə  [paʔa  laplaš]]
   drop-NTR-1SG.ERG  [DET  [one  board]]
   ‘I dropped one board.’

b. nam-at-as-ul  [tə  [p<aʔ>a<p>yaʔ  pipa]]
   write-CTR-3ERG-PST  [DET  [one<PL><DIM>  paper]]
   ‘She wrote the papers, one at a time.’  (Mellesmoen, in press)
   Literally: ‘She wrote the one by one papers.’

Table 1 summarizes the range of syntactic environments where bare (paʔa) and distributive (paʔapyaʔ) numerals are found. Their distribution is identical, showing that there is nothing special about the syntax of distributive numerals relative to bare numerals. However, the compositionality issues are more problematic for distributive numerals, because of the semantic requirement that they distribute over sub-events, irrespective of their syntactic environment.

<table>
<thead>
<tr>
<th>Role of numeral</th>
<th>Syntactic environment</th>
<th>Bare numeral e.g., paʔa</th>
<th>Distributive numeral e.g., paʔapyaʔ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main predicate</td>
<td>with a nominalized complement clause argument (33)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td></td>
<td>with a relative clause argument (34), (35)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td></td>
<td>with a simple DP argument (36)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Predicate modifier</td>
<td>in a complex nominal predicate (37)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Argument modifier</td>
<td>adjoined to NP (38)</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td></td>
<td>adjoined to DP (39)</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Table 1: Syntactic environments for ?ayʔajuθəm numerals

As indicated above, the compositionality problems raised by the flexible syntax of numerals – more specifically, of distributive numerals – can be divided into two types. The first is where the predicate of events that acts as the argument of the distributed numeral is not overtly present at all: this is most obvious with non-clausal DP arguments, as in (36). The second is where the predicate of events is in the wrong syntactic position to compose with the distributed numeral, either because it is embedded inside a DP complement (as in the relative clause cases in (34) and (35) as well as the complex nominal predicate case in (37)), or because the distributed numeral is embedded inside a DP complement to the predicate, as in the argument modifier cases in (38) and (39). We discuss the ‘missing argument’ problem in 4.2, before turning to the
more difficult ‘argument ordering’ cases in 4.3.

4.2 The missing (semantic) argument problem

ʔayʔaǰuθəm distributive numerals may appear with only a nominal argument, yet give rise to pluralactional readings in which sub-events are distributed over. This is illustrated in (40) and (41), which are a minimal pair differing only in discourse context, and in (42)-(43). (36b) was also an example of this phenomenon.

(40) Context: There are a bunch of bagels left over after a party and Kaining asks what she should do with them. I say:

\[
\begin{align*}
p < a^ʔ > a < p > ya^ʔ & \quad [ \text{bagels}] \\
one < \text{PL} > < \text{DIM} > & \quad [[\text{DET}] \text{ bagels}] \\
\text{‘(Eat) the bagels, one by one.’} & \quad \text{(Mellesmoen, in press)}
\end{align*}
\]

(41) Context: We left some bagels sitting out for too long after a lab party and now they are stale and no longer good to eat. I am throwing bagels at other members of the lab group and Kaining asks what she should do with them. I say:

\[
\begin{align*}
p < a^ʔ > a < p > ya^ʔ & \quad [ \text{bagels}] \\
one < \text{PL} > < \text{DIM} > & \quad [[\text{DET}] \text{ bagels}] \\
\text{‘(Throw) the bagels, one by one.’} & \quad \text{(Mellesmoen, in press)}
\end{align*}
\]

(42) Context: Elicited with a set of pictures.

\[
\begin{align*}
p < a^ʔ > a < p > ya^ʔ & \quad [ \text{qʷasəm}] \\
one < \text{PL} > < \text{DIM} > & \quad [[\text{DET}] \text{ flower}] \\
\text{‘(He is throwing) the flowers, one at a time.’} & \\
\text{‘(She is catching) the flowers, one by one.’} & \\
\text{‘(She is painting) flowers one at a time.’} & \\
\text{‘(She is drying) flowers, one at a time.’} &
\end{align*}
\]

(43) s < a^ʔ > a < s > ya^ʔ  
\[
\begin{align*}
two < \text{PL} > < \text{DIM} > & \quad [[\text{DET}] \text{ PL~cat}] \\
\text{‘He is doing (squeezing) the cats, two by two.’} &
\end{align*}
\]

Apart from the missing verb, these cases are important because they bring to light a point about the individual argument which is targeted by the distributive numeral. All the cases in (40)-(43) involve the relevant participants being introduced by the direct object of a transitive predicate. They thus differ from earlier examples like (44) (repeated from (30)), where the relevant participants are represented by the subject of an intransitive predicate:

(44) s < a^ʔ > a < s > ya^ʔ  
\[
\begin{align*}
two < \text{PL} > < \text{DIM} > & \quad \text{[DET]} \text{ [NMLZ] wake-MID DET PL~cat]}
\end{align*}
\]
‘The cats woke up two by two.’

The fact that the relevant argument can be the object, not the subject, is not actually specific to cases without overt verbs; (6) above, repeated here as (45), is an example of this. Here the object is phonologically null rather than the verb, but the interpretive schema parallels the data set immediately above.

(45) Context: Bruno ate cookies stacked two on top of each other, but some are left on the plate.

s<aʔ>a<s>yaʔ  [ mə~mkʷ-t-as]
two<PL><DIM>  [[DET] IPFV~eat-CTR-3ERG]
‘He is eating them two at a time.’

(44) requires the cats to wake up in groups of two, while (43) requires the agent (‘he’) to squeeze cats in groups of two and (45) requires the agent (Bruno) to eat cookies in groups of two. We conclude that the distributive numeral has to be able to ‘see’ any salient participant role in an event; that is why we introduced the PARTICIPANT operator in (31) above.16

Returning to the ‘missing’ verbal predicate in cases like (40)-(43), for now we model these as simply involving a phonologically null light verb, or a syntactic process of verb ellipsis. Once this is assumed, they can be dealt with in the same way as we outlined for cases like (30) earlier.17

4.3 The argument ordering problem

A more tricky compositionality problem is posed by those syntactic configurations where the distributive numeral does not receive an argument of the right type – in particular, it does not receive a predicate over events. Take, for example, the case of a predicative distributive numeral with a headed relative clause, illustrated in (46) (repeated from (34b)):

(46) p<aʔ>a<p>yaʔ  [tə cars kʷə~kʷt-igan]
one<PL><DIM>  [DET cars IPFV~pass.by-side.of.body]
‘One by one, the cars passed by.’
Literal: ‘The cars that passed by were one by one.’

The analysis presented in Section 3 involves a pluractional morpheme which takes two arguments: first, a numeral predicate (to which it infixes) and second, a predicate of events (the syntactic sister of the numeral). This allows the distributive numeral to (a) temporally distribute over sub-events and (b) count the atomic individuals involved in each sub-event. In the case of (46), then, the infix would need to apply to a set of events of cars passing by – but this is not provided by the syntax. The event of cars passing by is existentially closed within the relative

---

16 Cable (2014:582) proposes a similar mechanism to deal with distributive numerals in Tlingit.
17 Of course, ideally we would have evidence for either a null light verb or a verb ellipsis process, neither of which at this point are independently syntactically motivated; this is a topic for future research.
clause (which denotes the contextually salient cars which passed by).

The two most obvious potential solutions to this problem both suffer from severe problems. The first is to maneuver constituents syntactically into positions where they can be composed in a well-behaved fashion. The problem with this is that the movements necessary for many of the cases listed in Table 1 violate well-established constraints on syntactic movement. In (46), for example, this would mean either that the predicate of events \( kʷəkʷtigən \) ‘pass by’ must raise out of a relative clause to a position where it combines with the matrix predicate \( paʔapyaʔ \), or equally hopelessly, the distributive numeral must lower to a position inside the relative clause where it can combine with the predicate of events. Neither option is viable on any reasonably constrained theory of syntactic movement.

A purely semantic alternative, instead, would consist of massive amounts of type-shifting. For (46), for example, we might type-shift the predicate \( kʷəkʷtigən \), so that rather than being a simple relation between individuals and events, it is an operator which takes a predicate of individuals (in this case, cars), and outputs a predicate of events (which are passings-by by cars). That could then compose with the distributive numeral to give the right meaning (setting aside the extra complication of the contribution of the choice function determiner, which we have ignored in this scenario). Similar type-shifts could account for the other syntactic environments summarized in Table 1 which remain unaccounted for, including the complex nominal predicates (as in (37b), ‘The ones she stole were one by one bagels’) and the cases where the distributive numeral is adjoined to a nominal argument (as in (38b)-(39b), ‘She wrote the one by one papers’). However, it is easy to see that this approach is a convenient way to ignore the syntax – a mechanism which would effectively nullify the predictions of compositionality.

In other words, there is no easy way to deal with these cases in a compositional fashion. Rather than attempting to propose a solution, we leave the problem for future work; however, before concluding, we offer some remarks on why distributive numerals should end up posing such a thorny problem for compositionality.

4.4 A syntax-semantics mismatch in the analysis of distributed numerals

The first key observation we want to stress here is that syntactically, distributive numerals show identical behavior to simplex numerals, which also occur as predicates, predicate modifiers, and argument modifiers (also mirroring the syntactic behavior of weak quantifiers such as ‘few’ or ‘many’ in Salish languages: see Matthewson, 1998).

The next thing to note is that the variety of positions occupied by simplex numerals do not cause the same types of problems for compositionality as distributive numerals. This is because simplex nominals are semantically as well as syntactically flexible; they can count events or individuals, and either act as intersective or non-intersective modifiers.

Distributive numerals in ʔayʔajuθəm, on the other hand, are semantically inflexible: they require both sub-events and individuals in their denotations. What this means is that the
distributional freedom which the syntax allows for all numerals runs into trouble when the semantics requires a very specific type of semantic composition, as with distributive numerals. The question now arises as to why the syntax of distributive numerals does not immediately adjust to only allow the restricted type of composition demanded by the semantics of the distributive numeral (essentially, the derivation given in (32)). The tentative answer we would like to suggest is that the syntax is partially ‘semantics-blind’: it provides the structures which allow composition, but is insensitive to the specific compositional demands of individual lexical items, whether primitive or derived.\(^{18}\)

How is the problem of mismatch then resolved? Possibly, by massive type-shifting of the kind contemplated unenthusiastically in the previous section. On this view, though, there are reasons why composition in this case looks so ugly: its job is to stitch up the syntax and the semantics in the best way it can, seamlessly in cases where the syntax and semantics correspond closely, but much more raggedly where they do not. In this respect, mismatched cases like the ?ayʔajuθəm distributive numerals provide important evidence for the (partial) independence of syntax from semantics, just as cases of prosody-syntax mismatch prove crucial in establishing the independence of prosodic and syntactic constituents.

It is also worth pointing out that although the ?ayʔajuθəm case is quite extreme, the compositionality issue has been raised many times before with distributive numerals, as pointed out for example by Cable (2014: 565) with respect to Tlingit:

This [distributed numeral] morphology somehow signals the distribution of a property larger than the constituent it marks, so there is an apparent mismatch between the surface location of this morphology (the numeral) and the locus of its semantic effect (the larger, distributed property).

5. Conclusion

This paper has provided the first detailed semantic examination of distributive numerals in ?ayʔajuθəm. We have established the following generalizations.

First, distributive numerals in ?ayʔajuθəm are restricted to temporal distribution over non-overlapping sub-events; in contrast, the related Salish language St’át’imcets permits its distributive numerals to distribute either over time or space, while unrelated Tlingit (Cable, 2014) allows distribution over time or event participants.

Second, distributive numerals in ?ayʔajuθəm are composed of three semantic components: the numeral itself; diminutive reduplication, which eliminates alternatives to the numeral and thus

---

\(^{18}\) We would like to propose this as a general statement about compositionality, but obviously, we are in no position to support it properly here. Systematic documentation across semantic domains and languages is necessary to establish how widespread syntax-semantics mismatches of this kind actually are; our impression is that they are quite pervasive with distributive numerals, but it remains to be seen whether this represents a special case or an instance of a wider phenomenon.
enforces an ‘exactly’ reading; and a pluractional infix, which adds to reduplicated numerals with cardinality \( n \) to yield a meaning of ‘\( n \) at a time’ by selecting an event argument, pluralizing and temporally distributing its sub-events, and counting the participants in each sub-event.

Finally, although we have provided a denotation for the ‘core’ case of distributed nominals, in which they act as predicates taking event descriptions as arguments, we have also pointed out that this is just one of a range of syntactic environments in which they may occur. The generalization governing these cases is a syntactic one: distributive numerals have an identical distribution to simplex numerals. Compositionality issues arise when the distributed numeral is syntactically separated from the predicate of events to which it applies, as for example, when the event is contained in a relative clause which is a syntactic sister to the numeral.

References


Decomposing distributive numerals in ʔayʔaǰuθəm (Comox-Sliammon Salish)


A scalar conditional in Greek: looking for the consequent\footnote{I am grateful to Kai von Fintel, Sabine Iatridou, Fabienne Martin, Sophie Moraccini, Andreea Nicolae, Giorgos Spathas, Vina Tsakali and the SuB24 reviewers and attendants for valuable feedback. I wish also to thank Irini Manolaki, Iro Malta and Vicky Rizou for their help with judgements and discussion. All errors are, of course, my own. This work is funded by AL 554/8-1 (DFG Gottfried Wilhelm Leibniz Preis 2014 to Artemis Alexiadou).}{\addcontentsline{toc}{section}{Abstract}
Despina OIKONOMOU — Humboldt-Universität zu Berlin

Abstract. This paper discusses a construction with a conditional interpretation in Greek which differs from “typical” conditionals in interesting ways. I refer to this construction as pu-conditional, since it is always introduced with the particle pu whose semantic contribution is to be analysed. Pu-conditional only appear with subjunctive mood and they do not combine with a consequent as typical conditionals. Instead, the meaning of the consequent is implied and indicates that if the prejacent holds, a contextually supplied scalar property will hold to a higher degree.

Keywords: Conditionals, Scalar particles, Even, Subjunctive mood, Expressives

1. Introduction

As highlighted in Iatridou (2014), conditional meaning can surface with different forms. The if \( p, q \) form is only one of them but crosslinguistically we find a variety of constructions which appear to have conditional interpetation (e.g. Conditional inversion, Conditional Conjunction, Imperative and Declaratives). This paper, discusses a conditional construction in Greek which deviates from the “typical” if \( p, q \)-conditional both structurally and semantically. pu-conditional are always introduced with the particle pu\footnote{The word \textit{pu} has different functions in Greek. It functions as i) the \textit{wh-}word ‘where’ as shown in (ia), ii) the \textit{relative complementizer} ‘that’ (ib) and iii) the factive complementizer in Greek (ic).}{\addcontentsline{section}{section}{1. Introduction}} and bear subjunctive mood whereas the consequent cannot be expressed as part of the same sentence. Instead, the meaning of the consequent is implied and indicates that if the prejacent holds, a contextually supplied scalar property will hold to a higher degree. For example, the sentence in (1) is uttered in a context where Mary is sad for some reason and the speaker knowing that Peter is Mary’s good friend implies that if Peter leaves, then Mary will be even sadder. Although throughout the paper I translate \textit{pu-}conditionals as \textit{imagine-if-}conditionals we will see that their semantics is quite different. However, this is, I think, the closest translation in English.

(1) Pu na figi o Petros.
PART SUBJ leave.3SG the Peter.NOM
‘Imagine if Peter leaves....’ ~ Mary will be even sadder.
\footnote{1I am grateful to Kai von Fintel, Sabine Iatridou, Fabienne Martin, Sophie Moraccini, Andreea Nicolae, Giorgos Spathas, Vina Tsakali and the SuB24 reviewers and attendants for valuable feedback. I wish also to thank Irini Manolaki, Iro Malta and Vicky Rizou for their help with judgements and discussion. All errors are, of course, my own. This work is funded by AL 554/8-1 (DFG Gottfried Wilhelm Leibniz Preis 2014 to Artemis Alexiadou).}
In the rest of the paper we try to uncover the special properties of this construction. In doing so, we discover interesting extensions which relate with the properties of scalar particles in natural language. In the following section, we try to pin down the meaning components of \textit{pu}-conditionals. In order to identify their meaning, we compare \textit{pu}-conditionals with the more widespread \textit{imagine-if}-conditionals suggesting that their distribution and therefore their semantical contribution is not equivalent. Their difference lies in an \textit{even}-component which \textit{imagine-if} conditionals lack. I show that the meaning of the particle \textit{pu} shares a core component with the meaning suggested for the English \textit{even} by Greenberg (2018). Related to this, we show that once \textit{imagine-if}-conditionals are supplemented with a special \textit{even} particle in Greek, \textit{ke}, they acquire similar restrictions as \textit{pu}-conditionals. In section 3, I highlight another characteristic of \textit{pu}-conditionals which distinguishes them from typical conditionals, their expresserive component, suggesting that there is an expressive operator involved in the spirit of Grosz (2012). In section 4, we discuss an homophonous construction which however differs in its prosody and conveys infeasibility. Section 5 concludes and points towards further implications.

2. Untangling the semantic contribution of \textit{pu}-conditionals

2.1. \textit{Pu}-conditionals vs. \textit{imagine-if}- conditionals: Presupposition restrictions

As the translation of (1) indicates, in many contexts, \textit{pu}-conditionals are interchangeable with “\textit{Imagine if}-conditionals”\textsuperscript{3} both inviting the hearer to imagine a situation if the prejacent holds. In the following we show that \textit{pu}-conditionals are more restricted by presenting environments where \textit{imagine-if}-conditionals are licensed but \textit{pu}-conditionals are not. The critical difference between the two is that \textit{pu}-conditionals require that there is a contextually supplied gradable property which holds at least to a contextually defined standard of comparison\textsuperscript{4}. Imagine a situation in which, without any pre-context, Speaker A utters (2a); his interlocutor might wonder what the speaker means but he understands that A invites him to consider what the world will be like if Peter leaves. A natural response if there is no context is “So, what will happen?” as in (2b). On the contrary, if a \textit{pu}-conditional as in (3a) is uttered out of context then the interlocutor wonders what he missed in the background and his first question is “Why? What happened?” (3b):

\begin{align*}
(2) & \quad a. \text{ A. Fantasu } \text{ na } \text{ figi } \text{ o } \text{ Petros.} \\
& \quad \text{ imagine SUBJ leave.3SG the Peter.NOM} \\
& \quad \sim \text{ ‘Imagine if Peter leaves....’} \\
& \quad b. \text{ B. Ee. } \text{ Ti } \text{ tha } \text{ gini?} \\
& \quad \text{ So.. What will happen?} \\
(3) & \quad a. \text{ A. Pu } \text{ na } \text{ figi } \text{ o } \text{ Petros.} \\
& \quad \text{ PART SUBJ leave.3SG the Peter.NOM}
\end{align*}

\textsuperscript{3}We do not attempt an analysis of \textit{imagine-if}-conditionals in this paper which are also interesting in their own. In particular, in Greek, as the glossing of the examples suggests \textit{imagine} combines with subjunctive and invites the hearer to imagine \textit{what will happen} if the subjunctive clause is true. The fact that \textit{imagine} combines with subjunctive in these environments is interesting on its own because by default \textit{imagine} selects indicative (notice though that the syntax of this construction is not entirely transparent, i.e. it is possible that the \textit{na}-clause is a subordinate of a covert \textit{what will happen} consequent. In this paper, we set aside questions concerning the internal make-up of \textit{imagine-if} conditionals and focus on their overall interpretation in comparison with \textit{pu}-conditionals.

\textsuperscript{4}See Kennedy and McNally (2005) for an extensive discussion on the definition and the computation of the contextual standard for different types of properties.
b. B. Giati? Ti egine? / #Ti tha gini
   Why? What happened? / #What will happen?

The contrast becomes even clearer in environments where imagine-if conditionals do not require any context because it is obvious what they ask whereas pu-conditionals are still judged infelicitous. The hypothetical in (4a) is general and interesting enough so that it doesn’t need any contextual background, it introduces a general philosophical concern.

(4) a. Fantasu na erthun i eksogiini.
   Imagine SUBJ come.3PL the aliens.NOM
   ‘Imagine if aliens come....’

b. Pu na erthun i eksogiini.
   PART SUBJ come.3PL the aliens.NOM

Pu-conditionals as in (3a) and (4b) can only be evaluated if the context makes salient a gradable property. This can be any gradable property and it doesn’t matter if it is positive or negative. For example, sadness as in (1) could be replaced by happiness (e.g. Mary is happy and will be happier if Peter leaves), messiness (e.g. the house is already messy and if Peter leaves it will be even messier as he is the only one who tidies up). A sentence as in (4b) would be licensed if, for example, the context established that there are technological developments in the 21st century, and then somebody (who actually believes that there is extra-terrestrial life) utters (4b) suggesting that the development will be even greater, if aliens come to earth. Without such a context however, the sentence is judged infelicitous contrary to (4a) which is fine even when uttered in an out-of-the-blue context.

This requirement suggests that pu-conditionals trigger a presupposition that the context involves a gradable property which holds at least to the contextual standard. In the following we present a meaning for pu-conditionals capturing their scalar character.

2.2. A meaning for pu-conditionals

In all of the examples, we have presented so far it becomes clear that pu-conditionals contribute at least two components of information:

1. They introduce a presupposition that a contextually supplied gradable property G holds for a salient entity α to a degree at least as high as the contextual standard.

2. They indicate that in all situations consistent with the speaker’s beliefs in which the prejacent of pu, p, is true, the gradable property G holds to a greater degree.

As the comparison with imagine-if-conditionals suggested, 1 & 2 are not plain contextual inferences but they are tied to the meaning of pu-conditionals. Based on the infelicity of the utterances in (3a) and (4b), we can tell that the first inference is a presupposition. For the second inference we will argue that it is part of the assertive component of pu-conditionals, i.e. that the speaker asserts that in all situations where p is true and consistent with what he believes, whatever the contextually supplied property for a salient entity α is, it holds to a greater

5For example, another consequent-less type of conditional suggested to me by a SUB-reviewer is ‘God forbid if Peter leaves.’ However, in contrast with pu-conditionals ‘God forbid-conditionals always indicates that the consequent will have a negative value.
degree. As we discuss in Section 3, due to the expressive character of pu-conditionals it is not easy to tease apart their presupposition vs. assertive component, but we will get back to this discussion when we will discuss their expressivity.

Based on this, a first version of the meaning of pu-conditionals is the following, where \( c \) is the context of the utterance which involves a judge \((J)\) and \( g \) is an assignment function. I assume in purpose a judge and not a speaker because we will see that although usually the judge is the speaker sometimes it can be a distinct individual.

(5) **Meaning of pu-conditionals** (first version)

\[
[pu]^{c,g}(p)(w) = \forall w. \text{DOX}_J(w') \land p(w') = 1 \rightarrow \text{MAX} d'[\lambda d'. G(d')(\alpha)(w')] > \text{MAX} d \left[\lambda d. G(d)(\alpha)(w)\right]
\]

In words, pu-conditionals trigger a presupposition that there is a contextually supplied gradable property \((G,<d,<e,\text{st}>))\) that holds for a contextually salient individual \( \alpha \) with a degree \( d \) at least as high as the contextually defined standard \((d_{\text{standard}})\) and they assert that in all words \( w' \), that conform to the judge’s beliefs and in which the prejacent proposition \( p \) is true, the gradable property \( G \) holds to a greater degree \( d' > d \) for the salient individual \( \alpha \).

Based on (5), the sentence in (1) means that in all worlds which are consistent with what the speaker believes in the actual world and in which Peter leaves, Mary is sadder than she actually is (presupposing that she is sad at least to \( d_{\text{standard}} \)):

(6) ** ((1)) **^{c,g} is only defined if for a salient individual \( \alpha (=\text{Mary}) \) in \( c \), the context provides a gradable property \( G (=\text{sadness}) \) that holds for \( \alpha \) such that \( \text{MAX} d \left[\lambda d. G(d)(\alpha)(w)\right] \geq d_{\text{standard}} \). If defined,

\[
[[((1))]^{c,g} = \forall w. \text{DOX}_J(w') \land \text{leave}(\text{Peter})(w') \rightarrow \text{MAX} d'[\lambda d'. SAD(d')(\alpha)(w')] > \text{MAX} d \left[\lambda d. SAD(d)(\alpha)(w)\right]
\]

There are many parts of this meaning which deserve our attention. We discuss these issues one by one below.

2.2.1. Conditional meaning

The meaning we provided for pu-conditionals is a conditional meaning implemented in a Kratzerian way. In accordance with their conditional meaning, pu-conditionals exhibit canonical “counterfactual” marking. Iatridou (2000) shows that in Greek, among other languages, certain combinations of Tense and Aspect result in a so-called counterfactual or a Future less vivid interpretation. The Future less vivid is expressed with Past Imperfective but crucially the conditional doesn’t have to refer to a past situation; it can refer to a future situation which is

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6 I assume that the element pu is responsible for the scalar conditional interpretation. It could also be that there is a covert operator and pu is only a discourse particle facilitating this interpretation. However, since without pu we cannot derive this meaning, I think it is legitimate to treat pu as a semantically contentful operator.

7 I would like to thank Kai von Fintel for bringing up this issue as well as a SUB-reviewer who raised the question about conditional interpretation.
still possible to be realized but not likely (i.e. a less vivid future). The *pu*-conditional in (7a) is a Future less vivid conditional, as shown by the possible continuation in (7b) suggesting that the prejacent is still a viable (though not vivid) possibility.\(^8\)

**Context:** Mary is very excited that most of her friends will come to her wedding... However, nobody knows yet whether Peter, her best friend, will come... In this context, we can utter (7a).

(7) a. *Pu* na erhotan ki o Petros, ee?  
    PART SUBJ come.IMPF.PAST.3SG ADD THE Peter.NOM ee  
    ‘Imagine if Peter came too...’

    b. Ande makari na erthi!  
    ANDE WISH.PART SUBJ come.3SG  
    ‘I wish he comes!!!’

The past counterfactual interpretation is realized with Past Perfect and is used for situations which were not realized in the past. Imagine again a wedding context, this time we discuss after the wedding and we know that Peter didn’t come. We are saying how much fun we had and we continue with (8) suggesting that if Peter had come we would have even more fun.

(8) *Pu* na ihe erthi ki o Petros...  
    PART SUBJ had come.PRTC ADD THE Peter.NOM  
    ‘Imagine if Peter had come...’  \(\sim\) *How much more fun we would have...*

Notice that we can also use Past Perfective like in typical conditionals in which case we refer to a situation in the past without knowing whether the prejacent is true or not (Past-non-counterfactual):

**Context:** Peter is recently very arrogant and all the time he talks about his achievements. Last month, he applied for a senior position at the university. The results have been announced but Mary doesn’t know what happened yet... So after explaining the situation to a friend, she goes on with (9), meaning that if they have hired him, he will be even more arrogant...

(9) *Pu* na ton pirane...  
    PART SUBJ him.CL take.PERF.PAST.3PL  
    ‘Imagine if they have hired him...’ \(\sim\) *How much more arrogant he will be...*

As Iatridou (2000) discusses, “counterfactual”-marking is also typical for wishes, but clearly as we have seen (and as we discuss in detail in Section 3) *pu*-conditionals do not function as wishes but rather as conditionals. The fact that they exhibit the same marking to express the Future less vivid and the past counterfactual makes this association even stronger.\(^9\)

\(^8\)It is a bit harder to have a continuation where we counterwish the prejacent. For example, imagine a context where we host already many people for the wedding and if Peter comes it will be unbearable. In this situation, we can utter (7a), meaning that if he was coming the situation would be unbearable but it seems that we are sure he will not come, i.e. a continuation like “*I hope he doesn’t come.*” doesn’t seem felicitous to me. However, I get a similar contrast for *if p,q* conditionals. In any case, the status of counterfactuality inferences seem to vary between different types of conditionals (see Iatridou 2000; FT. 2, p.233) but this doesn’t change the fact that the particular marking corresponds to a future less vivid interpretation.

\(^9\)Of course, the counterfactual readings cannot be captured by the semantics we have attributed the *pu*-operator in (5), but whatever analysis one follows for counterfactuals with *if p,q* conditionals can be extended to explain *pu*-conditionals.
2.2.2. On \( d \geq d_{\text{standard}} \) and \( d' > d \)

In Section 2.1 we showed that \( pu \)-conditionals are defined only if there is a contextually supplied gradable property \( G \). We also said that it is a necessary requirement that the degree of \( G \) is equal or higher than the contextual standard \( (d_{\text{standard}}) \) but we didn’t provide evidence for this. Imagine we introduce a gradable property but it doesn’t meet the contextual standard. For example, the contextually supplied gradable property of ‘likeness’ is below the contextual standard in (10) and, therefore, the \( pu \)-conditional following is infelicitous. Notice that an \( imagine-if \)-conditional as in (10b) can be felicitous, since we are more flexible as to how to interpret the consequent. The sentence in (10b) suggests that if the addressee sees George with a costume he might actually like him.

(10) A. Did you like George...
    B. So...so...
      a. A. \( #Pu \) na ton dis (emos) me kostumi...
         PART SUBJ him.CL see.2SG though with costume
      b. A’. \( \checkmark \) Fantasu na ton dis omos me kostumi
         Imagine.IMP SUBJ him.CL though with costume

In addition, the degree of the gradable property cannot be equal with the maximum degree in the scale, since in this case, the assertive component that if the prejacent holds, the gradable property holds to a higher degree cannot be satisfied. Such examples, are difficult to construct because even when we are dealing with endpoints in a scale we can always imagine there could be a higher boundary. For example, imagine the tragic scenario that an entrepreneur commits suicide after bankruptcy. In this context, suppose we know that the bank was planning to sell his house at auction, still (11) sounds infelicitous because it is difficult to imagine a worst scenario than suicide (which indicates a highest degree of desperation).

(11) A. \#Pu na ihe mathi gia to spiti.
    PART SUBJ had learn.PRTC for the house
    \( \sim\sim \) ‘Imagine if he had learnt about the house.’
    B. Why? what worse could have happened?

Finally, notice that the inference is necessarily about a higher degree not lower. Once more the contrast with the \( imagine-if \)-conditional suggests this is not a contextual restriction but part of the semantics as the meaning in (5) suggests.

Context: Mary is very happy today. Her friends though know that she has failed the exam. In this context, (12a) is infelicitous whereas (12b) is felicitous, i.e. (12b) can have a continuation
\( It \) \( will \) \( be \) \( so \) \( tragic \) \( to \) \( spoil \) her \( happiness \).

(12) a. \#Pu na mathi gia to diagonisma...
    PART SUBJ learn.3SG for the exam.
  
  b. \( \checkmark \) Fantasu na mathi gia to diagonisma...
    imagine SUBJ learn.3SG for the exam.
    ‘Imagine if she learns about the exam...’ \( \sim\sim \) her happiness will evaporate...

\(^{10}\) Thanks a SUB reviewer who brought up this issue and suggested an example along the lines in (11).
These meaning components of *pu*-conditionals that concern the scalar property and the degree inferences are also found in other elements cross-linguistically. As we mentioned in the introductory section, according to Greenberg (2018), the contribution of the English *even* is very similar in some respects with the contribution of *pu*-conditionals.

2.2.3. *pu*-conditionals and the *even* component

The meaning we assigned for the *pu* operator shares a basic component with the meaning for *even* suggested by Greenberg (2018). Building on Rullmann (2007), she presents arguments against the analysis of *even* as operating on a likelihood scale and suggests instead a *gradability-based scalar presupposition* for *even*. Here is her first version which suffices for now:

\[(13)\] Gradability-based scalar presupposition, Greenberg (2018);(26), p. 61

For all \(q\): \(q \in C \land q \neq \overline{p}\), \(even(C)(p)(w)\) presupposes that for some salient entity \(x\) (denoted by some nonfocused or contrastive topic constituent in \(p\)) and a contextually supplied gradable property \(G\), the following holds: \(\forall w_1, w_2 [w_1 \mathcal{R} w \land w_2 \mathcal{R} w \land w_2 \in p \land w_1 \in [q \land \overline{p}] \rightarrow [\text{the max}d_2 (\lambda d_2. G(d_2)(x)(w_2)) > \text{the max} d_1 (\lambda d_1. G(d_1)(x)(w_1)) \geq \text{stand}_G] \)

In Greenberg’s words, the presupposition requires that with respect to \(x\), a nonfocused element in the prejacent of *even*, \(p\), and \(G\), a contextually supplied gradable property, the following two conditions hold: (a) \(x\)’s maximal degree on the scale associated with \(G\) is higher in all accessible \(p\) worlds than in all accessible \(q\)-and-not-\(p\) worlds and (b) in the latter kind of worlds \(x\)’s degree on \(G\) is at least as high as the standard of \(G\).

The core components that *even* and *pu* share are:

1. The presupposition that there is a gradable property which holds at least to the contextual standard.

2. The comparison between \(p\) and \(\overline{p}\) worlds in terms of the degree of \(G\).

Clearly, there are also differences which explain the different distribution of the two constructions. First of all, we have treated comparison between \(p\) and \(\overline{p}\) worlds as an assertion and not as a presupposition as it is the case for *even*. In addition to this, whereas *even* by its meaning associates with focus and always presupposes a set of alternatives, *pu* doesn’t have to associate with focus. For example, in (1) and (4b) *pu* does not associate with a focused constituent (and of course there is no additive presupposition either). The second difference is that whereas the entity that the gradable property holds of needs to be part of the prejacent of *even (a nonfocused element in the prejacent)*, in the case of *pu* this salient entity can be retrieved from the context even if it is not linguistically encoded. In the case of (1), we measure the degree of sadness for *Mary* who is a salient topic in the context. This salient topic can also be the speaker or the addressee. For example, in (14), it is clear that we compare degrees of astonishment for the speaker, who is the salient individual in this case.

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11Greenberg (2018) introduces a revised version which instead of absolute degrees compares *extents* of degrees. This revision is in order to capture certain data which are not relevant for this paper.
Context: The speaker visits his friend’s lab and he sees a tiny laptop which can solve difficult problems. In this context, he says “Wow... there is great technological advancement...” Then his friend can answer back with (14) suggesting that if the speaker sees their recently constructed robot his admiration/astonishment will be even greater:

(14) Pu na dis to kenurgio mas robotaki.
    PART SUBJ see.2SG the new our robot.DIMIN
    ‘Imagine if you see our new robot...’ 〜 Your admiration will hold to a larger degree.

Crucially, if the context allows such a switch we can even have admiration for a different object. Suppose that the lab-visitor looks at the robot and he seems astonished... Then, the lab-person who wants to tease her friend, can answer back with (15):

(15) Pu na fas dolmadakia tu Petru.
    PART SUBJ eat.2SG dolma the.Gen Peter.Gen
    ‘Imagine if you eat dolma by Peter...’ 〜 Your admiration will be greater.’

Given the even component in pu-conditionals, the question is if we find a Greenberg-even operator in Greek which can appear in imagine-if-conditionals and give us the same restrictions. Pu-conditionals often come with the scalar particle ke (hence, ke\textsubscript{sc}).\textsuperscript{12} Ke\textsubscript{sc} is optional but especially in some cases it is strongly favored. We can take any of the examples, with pu-conditionals, we have presented in this paper and add ke\textsubscript{sc} and this doesn’t seem to change anything in their meaning or presuppositions. On the contrary if we add ke\textsubscript{sc} to imagine-if-conditionals their distribution is constrained similarly to pu-conditionals. Consider for example the pair in (10). Once we add ke\textsubscript{sc} to the imagine-if-conditional (16b), it becomes odd like its pu-counterpart.

(16) A. Did you like George...
    B. So...so...
    a. A. #Pu na ton dis (ke) me kostumi...
       PART SUBJ him.CL see.2SG ke\textsubscript{sc} with costume
    b. A’. #Fantasu omos na ton dis ke me kostumi
       Imagine.IMP though SUBJ him.CL see.2SG ke\textsubscript{sc} with costume

We conjecture that ke\textsubscript{sc} contributes a presupposition similar to the assertive component of the pu-conditional.\textsuperscript{13} The fact that in many cases ke\textsubscript{sc} is preferred with pu-conditionals can be then treated as a version of the principle of Maximise Presupposition (Heim, 1991; Sauerland,

\textsuperscript{12}Ke is a multifunctional element in Greek. First, it is the run-of-the-mill conjunction. Second, it is a pure additive particle which is focus sensitive (Chatzikyriakidis et al., 2015). It is also reported to appear in unlikelihood environments as a counterpart of akomi ke which in Greek is clearly an unlikelihood ‘even’ (Giannakidou, 2007). This case is clearly different and to my knowledge it has not been discussed in the literature. Thanks to Vina Tsakali and a SUB-reviewer for questioning the role of ke in these environments.

\textsuperscript{13}This function of ke deserves much more to be said than we can say in the scope of this paper. For example ke\textsubscript{sc} seems to be a discourse particle rather than a focus particle. As it has been discussed in Chatzikyriakidis et al. (2015), Greek focus particles need always to be adjacent with the focus constituent, i.e. the additive ke necessarily precedes the focused constituent. On the contrary, ke\textsubscript{sc} preferably appears after the verb and in any case its position doesn’t seem to affect the interpretation:

Context: Nick woke up very happy today...
(i) a. Tu estile ke i mama tu ton baklava.
    him.CL.DAT send.PAST.3SG KE\textsubscript{sc} the mama.NOM his the baklava
2008). Ke_{sc} contributes the following presuppositions:

(17) Presupposition of $ke_{sc}$
\[
\lbrack [ke]^{\text{sc}}(p)(w) \rbrack \text{ is only defined if } i) \text{ c provides a salient individual } \alpha \text{ and a gradable property } G \text{ that holds for } \alpha, \text{ such that } \max_d [\lambda d. G(d)(\alpha)(w)] \geq d_{\text{standard}} \text{ and ii) } \forall w_1, w_2, DOX_j(w_1) \land p(w_1) = 1 \land DOX_j(w_2) \land p(w_2) = 0 \rightarrow \max d_1 [\lambda d_1. G(d_1)(\alpha)(w_1)] > \max d_2 [\lambda d_2. G(d_2)(\alpha)(w_2)].
\]

$Ke_{sc}$ can appear in any declarative sentence. Consider our original example: in a context where Mary is sad, one can utter (18) if he knows that Peter left implying that since Peter left, Mary will be even sadder. Notice that without $ke_{sc}$ the sentence sounds infelicitous in this context or it would be interpreted as a cause for Mary’s sadness, not as cause for Mary’s greater sadness.

(18) Efige $ke$ o Petros...
     leave.PAST.3SG $ke_{sc}$ the Peter.NOM
     ‘On top of this, Peter left...’

$Pu$ and $ke_{sc}$ differ in that the first one asserts the conditional whereas in the latter it is a presupposition. This difference should be detectable in the way we can target this inference. It seems that we can respond to (1) with “I don’t agree” but we cannot do so for the sentence in (18). We cannot simply reject (18) by saying “I don’t agree... I think she will be happy actually”. As we said it is not easy to tease apart the assertion from the presupposition in $pu$-conditionals but this contrast provides at least a suggestion.

2.2.4. Comparison between two salient entities: the effect of focus

All the examples of $pu$-conditionals we have provided so far suggest that the comparison is between degrees for a gradable property that holds for a single entity. This is captured by our semantics since the gradable property holds for a contextually salient entity $\alpha$. However, in some cases it is possible that we compare degrees for the same gradable property but for two different entities. The sentence in (19) is ambiguous; pragmatically, the most accessible reading is that Ana will be even happier than Peter if she learns that Gaga came. Another possible but pragmatically less likely reading is that Peter will be even happier if Ana learns that Gaga came (Ana may actually be sad).

Context: Somebody says: Peter is very happy that Gaga came.

(19) $Pu$ na mathi i Ana ta nea!
     PART SUBJ learn.3SG the Ana the news.

b. Tu estile $ke$ ton baklava i mama tu.
     him.CL.DAT send.PAST.3SG $ke_{sc}$ the baklava the mama.NOM his
     ‘On top of this, his mom sent him baklava.’

c. ?Tu estile ton baklava $ke$ i mama tu.
     him.CL.DAT send.PAST.3SG the baklava $ke_{sc}$ the mama.NOM his

d. #ke i mama tu tu estile ton baklava.
     $ke_{sc}$ the mama.NOM his him.CL.DAT send.PAST.3SG the baklava.

The analysis of $ke_{sc}$ as a discourse particle and its relation with the focus additive particle $ke$ is interesting given recent work on the relation between focus and discourse particles (Grosz, 2016). However we have to leave further investigation of this issue and the exact role of the scalar $ke$ for future research.
R1: ‘Imagine if Ana learns about it... ℳ→ She will be even happier than Peter.
R2: ‘Imagine if Ana learns about it... ℳ→ Peter will be even happier than he is now.

Crucially, the first and most straightforward reading is not captured by our semantics and therefore we need to revise (5) in order to capture examples like this. Before doing so however it is important to understand under which conditions we can compare degrees that concern two distinct individuals.

In (19) Ana necessarily bears focal stress, for the first reading. If not, only the second reading survives. This suggests that we can compare degrees for two distinct entities only if the second entity is a focused element in the prejacent of pu, p. Whereas we will argue that this indeed the case, there is an apparent counterexample. Consider the sentence in (20), given the context, the most straightforward reading, is the first one, that the speaker’s dad will get angrier than Peter’s dad. For this reading, focusing is again necessary to introduce a second salient entity, but crucially this is distinct from the entity denoted by the focused constituent (i.e. speaker vs. speaker’s father). In this case, we cannot argue that the second entity which is introduced needs to be a focused element of p. However, the sentence in (20) can be read in a slightly modified way; Peter is in trouble and if the speaker runs as a candidate he(=speaker) will be in even more trouble. We take then the comparison to be between the speaker (which is denoted by the focused constituent) and Peter.

Context: Peter’s dad is very angry because Peter was involved in politics and ran as a candidate for a university party, then Mary says:

(20) Pu na katevo EGO ipopsifia...
    PART SUBJ run.1SG I candidate.
    ℳ→ R1: ‘Imagine if I run as a candidate...’ → My dad will be even angrier than Peter’s.
    ℳ→ R1’: ‘Imagine if I run as a candidate, ℳ→ I will be in more trouble than Peter.
    ℳ→ R2: ‘Imagine if I run as a candidate...’ ℳ→ Peter’s dad will get even angrier.

Evidence that the compared entity, if distinct, needs to be denoted by the focused constituent, comes from the following example. In (21) the first reading is not available even if we know that Gaga is Mary’s favorite singer and that Adele is Sofia’s favorite singer. Even in the case that we know that Mary doesn’t like Adele, which makes the second reading highly unlikely, the first reading doesn’t become available.

Context: Mary is excited because Gaga is giving a concert in her town! John and Sofia discuss about it, and then John, knowing that Adele is Sofia’s favorite singer, tells her:

(21) oh, oh... Pu na ethi i Adele, ee?
    oh oh PART SUBJ come.3SG the Adele, ee
    #R1: ‘Imagine if Ad. comes...’ ℳ→ You(=Sofia) will be even more excited than Mary.’
    √R2: ‘Imagine if Ad. comes...’ ℳ→ Mary will get more excited.

Differently, from (20), in (21) the focused constituent Adele is not affected in any possible way from Sofia’s emotions and therefore we cannot make any comparison salient between Adele and Gaga. Therefore, we conclude that focusing is a necessary condition in order to have comparison between two entities and, in addition, that the second entity is identical with the focused constituent in the prejacent of pu. Given these restrictions, we suggest a second version for the meaning of pu-conditionals, which intends to capture comparison between two entities.
The presupposition is always the same. What changes is that if there is a focused constituent and if the initially contextually salient individual $\alpha$ is an element of the alternatives of the focused constituent, then the comparison is between $\alpha$ and the focused constituent (cf. the third version of the meaning for even in Greenberg 2018, where she captures the comparison between two contrastive topics). Otherwise, the comparison concerns always a unique individual $\alpha$. Following Wagner (2006), $F$ stands for the focused constituent, which in our case is necessarily a type $e$ expression and $P$ stands for the lambda-abstracted property.

(22) Meaning of $pu$-conditionals (second version)

\[ [pu]^{c-f}(F)(P)(w) \text{ is only defined if for a salient individual } \alpha \text{ the context provides a gradable property } G \text{ that holds for } \alpha \text{ such that } \text{MAX } d [\lambda \alpha. G(d)(\alpha)(w)] \geq d_{\text{standard}}. \]

If defined, then

i) if $\alpha \in \text{ALT}_c(F)$, then:

\[ [pu]^{c-f}(F)(P)(w) = \forall w'. \text{ DOX}_J(w') \land P(F)(w') = 1 \rightarrow \text{MAX } d'[\lambda \alpha. G(d')(F)(w')] > \text{MAX } d [\lambda \alpha. G(d)(\alpha)(w)] \]

ii) if $\alpha \notin \text{ALT}_c(F)$, then:

\[ [pu]^{c-f}(F)(P)(w) = \forall w'. \text{ DOX}_J(w') \land P(F)(w') = 1 \rightarrow \text{MAX } d'[\lambda \alpha. G(d')(\alpha)(w')] > \text{MAX } d [\lambda \alpha. G(d)(\alpha)(w)] \]

With this modification we can account for all instances of $pu$-conditionals, except that we still miss a component of their meaning related with their expressive character.

3. $pu$-conditionals and expressivity

The meaning of $pu$-conditionals as presented so far predicts their felicity in the following example where the context provides a gradable property (e.g. thickness) which holds to the contextual standard. However, the sentence in (23) - although we understand very well what it means - sounds odd in a neutral lecture context. Unless we accommodate some attitude by the speaker towards the thickness of the mixture the sentence is not felicitous.

Context: A chef is presenting some thickening effects in class. With neutral intonation he says “Now this mixture is thick...” and he goes on again with neutral intonation and utters (23):

(23) #Pu na to valume sto psigio... PART SUBJ it.CL put.1PL in-the fridge
\[ \sim \text{‘If we put it in the fridge, the substance will become even thicker...’} \]

The sentence improves greatly if we allow the chef to express some attitude towards the thickness of the mixture. For example, if the chef expresses surprise (e.g. Wow!) or worry (e.g. oh! / aman!) or satisfaction (e.g. Nice! / Perfect!) as in (24a), the continuation with a $pu$-conditional becomes felicitous.

(24) a. Wow! / oh!/ Orea! to migma ine pahirefsto!
\[ \text{wow! / oh/ Nice! the mixture is thick} \]

b. $\check{v}$Pu na to valume sto psigio... PART SUBJ it.CL put.1PL in-the fridge
\[ \sim \text{‘If we put it in the fridge, the substance will become even thicker...’} \]

We argue that this behavior is due to the expressive character of $pu$-conditionals. By expressive we mean that there is a component in the meaning of $pu$-conditionals which is performative (i.e.
not descriptive) and as a result not subject to rejection or verification (see Potts 2007). Before moving on to an analysis of expressivity, let us go through some examples which actually show the expressive character of pu-conditional. Potts (2007) provides the following characteristics for expressive content:

1. **Independence**: Expressive content contributes a dimension of meaning that is separate from the regular descriptive content.
2. **Nondisplaceability**: Expressives predicate something of the utterance situation.
3. **Perspective dependence**: Expressive content is evaluated from a particular perspective. In general, the perspective is the speakers, but there can be deviations if conditions are right.
4. **Descriptive ineffability**: Speakers are never fully satisfied when they paraphrase expressive content using descriptive, i.e., nonexpressive terms.
5. **Immediacy**: Like performatives, expressives achieve their intended act simply by being uttered; they do not offer content so much as inflict it.

Independence and Descriptive ineffability are closely related given that both properties refer to the need to separate descriptive from expressive content. In the case of pu-conditional this is not always simple, because part of the descriptive content is a presupposition, therefore not-at-issue, but in a different way. However, it seems that we can agree or disagree with the assertive component but we cannot do the same for the expressive component. Let us consider again our first example, repeated in (25). In response to (25), the interlocutor can disagree that Mary will be even sadder, but he cannot target the speaker’s attitude, i.e. he cannot deny it or disagree with it but crucially he can target the sincerity of his actions/behavior as (25d) shows.

**Context**: Mary is sad because there is a disturbing situation. The speaker knowing that Peter is Mary’s good friend implies that if Peter leaves, Mary will be even sadder.

(25) a. Ah... Pu na figi o Petros.  
   Ah... PART SUBJ leave.3SG the Peter.NOM  
   ‘Imagine if Peter leaves....’ ~ Mary will be even sadder.

b. √Mba... den ine alithia... tha harei pu tha glitosi aftos tulahiston.  
   NO NEG is true FUT be-happy that FUT escape.3SG he at-least.  
   ‘No... It’s not true... She’ll be happy that he will at least escape (this situation).’

c. #(Mba...) Den ine alithia, den niazese gia tin Meri...  
   NO NEG is true NEG care.2SG for the Mary  
   ‘No... It’s not true.... You don’t care about Mary.’

d. √Ipokrinese... den niazese gia tin Meri...  
   Pretend.2SG NEG care.2SG for the Mary  
   ‘You pretend (to worry)... You don’t really care for Mary...’

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14Potts (2007) also mentions Repeatability as a characteristic of expressive content, but it has been shown that this is not a reliable diagnostic (Gutzmann, 2013; Grosz, 2011), and in addition it is not applicable here since expressivity comes from the properties of subjunctive mood, not from a lexical element.
In addition, *pu*-conditionals share another characteristic with expressive utterances, related to the property of *Nondisplaceability* and *Perspective Dependence*. Like optatives, their embeddability is restricted. The expressive meaning is anchored to the utterance situation and usually to the speaker’s perspective. Although *pu*-conditionals also have an assertive component, which as we saw above we can challenge, they exhibit similar embedding restrictions to optatives, imperatives and exclamatives (see Grosz 2011). They are better under the verb *leo ‘say’* and not so good with verbs like *believe, claim, hope*.

(26) ?i Rosa lei / {?#pistevi / ipostirizi} oti pu na erthi o aderfos tis...
the Rosa says / believes / claims that PART SUBJ come.3SG the brother his
‘Rosa says/believes/claims that if her brother comes...(the situation will become more...)’

The person seems also to play a role, for example embedding under *skefome ‘think’* is possible for 1st person but it is degraded with 3rd person (27). This contrast suggests a preference for *pu*-conditionals to be anchored to the speaker.

**Context:** Mary has started working in a kindergarten and she looks devastated then I ask her “What’s the problem?” / or I ask another employee “What’s her problem?”

(27) ✓ Skefome/ #skefete oti pu na erthun ke ta ipolipa pedia.
think.1SG think.3SG that PART SUBJ come.3PL KE the other children
‘{I think} / {she thinks} that if the rest of the children come as well...’ ~ ~ The situation will become even worse...

*Pu*-conditionals are also degraded when embedded under *because*. There is a contrast between (28a) and (28b):

**Context:** Peter is in a bad psychological state...

(28) a. Kalitera na min tu to pume giati an to mathi...
Better SUBJ NOT him.CL it.CL say.1PL because if it.CL learns FUT
‘Better not tell him about it because if he learns about it...(he will get worse)’

b. #?Kalitera na min tu to pume giati pu na to mathi...
Better SUBJ NOT him.CL it.CL say.1PL because PART SUBJ it.CL learns

However, this doesn’t mean that we cannot use a *pu*-conditional to argue against or in favor of the prejacent. What is odd in (28b) is that the *pu*-conditional is embedded under *because*. The utterance in (29) sounds much better but in this case the speaker seems to be emotionally more involved than in (28a). For example, (28a) can be uttered by a doctor in a hospital whereas (29) fits better as an utterance by a friend or a relative, somebody who really cares about Peter’s situation.

**Context:** Peter is in a bad psychological state...

(29) Pu na mathi gia tin Ana... Kalitera na min tu to pume!
PART SUBJ learn.3SG about the Ana... Better SUBJ NEG him.CL it.CL say.1PL
‘Imagine if he learns about Ana... Better we don’t tell him.’

The last example is also relevant for another property of expressive content, *immediacy*. Simply by uttering a *pu*-conditional, the speaker directly conveys his *worry/sadness* about the situation.
and as we showed with (25) we can only target the sincerity of the speaker’s behavior not the truth-content of what he says.

Having shown that pu-conditionals are expressive, the first question which arises is the source/trigger of expressivity; Given the fact that all matrix subjunctives seem to have an expressive component we don’t want to tie expressivity in particular to pu-conditionals but ideally associate expressivity with the properties of matrix subjunctives in Greek.\(^\text{15}\) Now the problem is that despite great progress, there are still many mysteries surrounding the notion of mood which we can hardly touch within the scope of this paper. For this reason, I just stipulate that all matrix clauses which bear subjunctive mood in Greek necessarily combine with an expressive operator of the type suggested by Grosz (2011, 2012).\(^\text{16}\)

According to Grosz (2011, 2012) an expressive operator (henceforth EX) combines with a proposition \(\phi\) and conveys an emotive or evaluative attitude towards \(\phi\). Crucially EX is scalar, i.e. it conveys the relative degree in a salient scale to which an emotive or evaluative property relativized to holds (usually for the speaker). This degree must exceed a salient threshold (\(\text{THRESHOLD}(c)\)).

Under this view then, the expressive operator EX combines with the pu-conditional and turns it into an expressive utterance (The EX-operator Hypothesis in Grosz 2011) thus explaining the expressive properties of pu-conditionals as opposed to if \(p,q\) conditionals. More formally, the contribution of the expressive operator is described as follows in Grosz (2011):

(30) For any scale \(S\) and proposition \(\phi\), interpreted in relation to a context \(c\) and assignment function \(g\), an utterance \(\text{EX}(S)(\phi)\) is felicitous iff \(\forall \psi [\text{THRESHOLD}(c) > S \psi \rightarrow \phi > S \psi]\)

a. \(\text{EX expresses an emotion that captures the fact that } \phi \text{ is higher on a (speaker-related) scale } S \text{ than all contextually relevant alternatives } \psi \text{ below a contextual threshold.}\)

b. \(\text{THRESHOLD}(c)\) is a function from a context into a set of worlds/a proposition that counts as high with respect to a relevant scale \(S\).

Grosz (2011), p. 69

This meaning gives us the flexibility we want for pu-conditionals since the relevant scale is not always the same; as we said, the speaker can express surprise or disappointment or enthusiasm or even finding something ridiculous or funny... various expressive particles can resolve this vagueness as suggested by the following example:

**Context**: This dress is short...

(31) Oh! / haha! / wow! / Orea! Pu na to plinume...
    Oh! / haha! / wow! / Nice! PART SUBJ it.cl wash.3SG...
    ‘Imagine if we wash it...’ ~~It will get even shorter.’

\(^{15}\)Being a subjunctive is not a necessary condition for expressivity. In particular, exclamatives can also be indicative and they are still expressive. However, being a matrix subjunctive seems to be a sufficient condition for expressivity, i.e. all matrix subjunctives are expressive in Greek. The question is, of course, what is considered matrix. For example, for pu-conditionals one can rightly argue that the subjunctive clause is embedded under pu. I would characterize matrix, a subjunctive not embedded under an overt tensed modal predicate.

\(^{16}\)Although, at this point, the association between subjunctive mood and expressivity remains a stipulation, it is definitely not a surprising association in view of the link between verbal and sentence mood (see Portner 2018 for an extensive discussion).
At this point, one might wonder whether it would actually be possible to reduce the meaning of *pu*-conditionals only to the expressive component. For instance in the previous example, we could argue that the relevant property is speaker’s happiness about the dress being short and that if the prejacent is realised the speaker will be even happier. Notice though, that in this case we wouldn’t necessarily get an inference that the dress will become shorter if we wash it (after all, usually dresses don’t get shorter if we wash them properly). Instead the inference that the dress will become shorter is an obligatory one and as we saw it can also be negated. In addition, if we were to reduce the meaning of the *pu*-conditional to the expressive component we would expect cases like the following to be good but they are not:

**Context:** We prepare a surprise-party for John. We want it to be a big nice surprise for him, so we hope that he will feel sad enough before the surprise (otherwise the surprise might not have the happy outcome we wish). In this context, one of us calls him to check and reports back: Good...He is sad enough!

(32)  

a. Orea! An tu kanume tin ekplaksi tora, tha ine telia!  
   Nice if him.CL do.3PL the surprise now FUT be perfect

b. Orea! Pu na tu kanume tin ekplaksi tora...  
   Nice! PART SUBJ him.CL do.3PL the surprise now...  
   → It can only mean: *If we make him the surprise now, he will be even sadder.*

This shows that *pu*-conditionals have two components, on the one hand they convey a scalar conditional meaning and on the other hand they communicate the speakers emotion/attitude towards the assertive component. This is a bit different from the analysis in Grosz 2011, 2012 because there there was only an expressive component, the contribution of the EX-operator conveying degrees of desire/surprise/etc. Below we discuss a second case where EX is interpreted on top of an assertion.

4. An homonymus construction: Unfeasible *pu*-subjunctives

There is a construction which looks like *pu*-conditionals, but its prosody and meaning is very different. Taking our original example in (1), repeated in (33), we see that it can also convey that the speaker doesn’t consider feasible the prejacent. Although, the two constructions look exactly the same, their prosody is very different, thus native speakers can clearly distinguish *pu*-conditionals from *pu*-subjunctives which convey unfeasibility (henceforth, USs). The focus on USs is on the particle *pu* and the rest is deaccented with a slightly rising boundary tone in the end\(^\text{17}\). On the contrary, in *pu*-conditionals, there is either broad or narrow focus on a particular constituent. The particle *pu* is never focused and it bears instead a Prenuclear Pitch Accent.

**Context:** We discuss about Mary’s plans to leave Germany because she has missed her family in Greece. Then somebody asks for Mary’s friend, Peter: “Is Peter also going to leave?” We can naturally answer with (33) conveying that we consider it unfeasible that Peter leaves. We can continue explaining the reasons, e.g. he has a good job here, he bought a house, etc.

\[17\] Their intonation can be less marked when they are conjuncted with *ala* ‘but’, e.g:

(i) Tu ipa na diavasi ala pu na diavasi aftos...  
   him.CL told SUBJ read.3SG but PART SUBJ read.3SG be  
   ‘I told him to study but I think it’s unfeasible for him to study...’
Notice that their meaning can be explicitly denied or confirmed similarly to what we have seen with the scalar meaning of pu-conditionals. For example, one can respond to (33) “I don’t agree. It think he might as well leave”. Unfeasibility seems to better describe what these pu-subjunctives convey, though it is not easy to tease apart the notion of unfeasibility from unlikelihood or difficulty. Interestingly, USs cannot be used in contexts where we know that the event conveyed by the prejacent has been realized but they can be used if we know that the event was not realized:

Context: John had an oral exam today morning... He comes out from the exam room and disappointed he says “I didn’t pass”... In this context, it is possible to say (34) meaning that the speaker considers that it was unfeasible for John to pass under the circumstances...

(34) Pu na perasis more.... Afu den anikses vivlio...
PART SUBJ pass.2SG PART Since NEG open.2SG book
~ Of course, it’s unfeasible to pass... since you didn’t even open a book...

Crucially, in a context, where finally, despite all expectations, by mere luck, John passed the oral exam, we cannot utter (34) meaning that the speaker considered it unfeasible that John would pass. I think that the reason for this is that USs refer to the speaker’s belief at the utterance time and therefore if the prejacent has been realized at the utterance time, it will be an obvious proof that the prejacent is feasible. Moreover, notice that although in (34) we refer to a past situation we cannot use Past tense. However, if we don’t know the outcome of the exam then we can use past tense:

Context: John had an oral exam today morning... He comes out from the exam room and disappointed he says “I didn’t do very well”... However, the results have not been announced yet and so he asks his colleague “Do you think it’s possible that I passed?”. Then, it is possible to answer with Past tense:

(35) Pu na perases more.... Afu den apantisise kamia erotisi...
PART SUBJ pass.PAST.2SG PART Since NEG answer.2SG to any question
~ I think it is unfeasible that you have passed... since you didn’t answer any question...

The licensing of past tense in (35) but not in (34) suggests that in the latter we make a more general claim about the unfeasibility of the prejacent under certain circumstances. Past tense is not licensed in (34) because the outcome is already known, so the speaker can only mean that he considers the prejacent unfeasible as a general claim.

Given this complicated picture, we do not try to give a precise meaning for USs. I hope it has become sufficiently clear that USs have different semantics from pu-conditionals (e.g. USs do not have counterfactual marking, they cannot combine with the scalar particle kec). What I would like to emphasize is the properties that the two constructions share; i) they both express

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18A different type of matrix subjunctives in Greek combines with the particle ande and conveys difficulty (Oikonomou, 2016; Demirok and Oikonomou, 2019). One major difference between the two is that andesubjunctives conveying difficulty can be used when the speaker admits that the prejacent will be realized whereas USs require that the speaker at the utterance time considers the prejacent unfeasible to be realized.
a scalar meaning (i.e. in the case of pu-conditionals there was a contextually supplied scalar property whereas in the case of USs there is an unfeasibility scale and ii) they are both expressive. Although, we didn't talk about the expressive character of USs, it is clear that they are not embeddable (at least no more than pu-conditionals), they cannot be uttered in an emotive-less context and usually some particle that encodes the speakers emotions is used (e.g. ah, oh, hehe). The expressivity of this construction adds up to the rest of matrix subjunctives which have an expressive character.

5. Concluding remarks: Gradability, subjunctive mood and expressivity

Pu-conditionals is one of these cases where a lot of information is conveyed by a single construction and that is what makes it interesting. First of all, the analysis of the scalar component revealed an operator which makes reference to a contextually supplied gradable property and contributes a conditional interpretation that is based on the comparison between two degrees. This highlights the possibility that cross-linguistically and within a language there are different varieties of even like the “typical” unlikelihood even in Greek, akomi ke (Giannakidou, 2007) or the scalar particle ke, which is closer to a Greenberg-even (but still different from it since it does not necessarily associate with a focused constituent) or a discourse even, scoping above speech acts (Iatridou and Tatevosov, 2016). More in-depth investigation can reveal subtler distinctions across various scalar particles cross-linguistically.

The second core component of pu-conditionals is subjunctive mood. So far, I have avoided on purpose to analyse the requirement for subjunctive mood with pu-conditionals. At a first level, under any theory of mood-selection, the meaning of pu-operator suggests that its complement should have subjunctive mood. Whether we take the original approach by Farkas (1992) which makes reference to strong and weak intentional contexts, a comparison-based approach as for example in Giorgi and Pianesi (1997); Villalta (2008), a veridicality based approach as in Giannakidou (2017) or a commitment-based approach (Portner and Rubinstein, 2012; Schlenker, 2005), pu-conditionals are predicted to surface with subjunctive mood. Therefore, in this respect they are not particularly helpful in evaluating different theories of mood selection.

Instead, pu-conditionals bring forth an interesting association between subjunctive mood in matrix environments and expressivity. Matrix subjunctives in Greek, except their modal interpretation which is clearly associated with subjunctive mood, also share an expressive component. We leave the question of why subjunctive mood contributes an expressive component in non-embedded environments for future research but we think that it may provide a different path to the overall understanding of the link between verbal and sentence mood (Portner, 2018).

References


Abstract. Using truth-value judgment tasks, we investigated the on-line processing of counterfactual conditionals such as *If kangaroos had no tails, they would topple over*. Face-value plausibility of the counterfactual as well as the complexity of the antecedent were manipulated. Results show that readers’ judgments deviate from face-value plausibility more often when the antecedent is complex, and when the counterfactual is plausible rather than implausible. We interpret our results based on the modal horizon assumption of von Fintel (2001) and argue that they are compatible with a variably strict semantics for counterfactuals (Lewis, 1973). We make use of computational modeling techniques to account for reaction times and truth-value judgments simultaneously, showing that implementing detailed process models deepens our understanding of the cognitive mechanisms triggered by linguistic stimuli.

Keywords: counterfactuals, modal horizon, computational modeling.

1. Introduction

Consider the sentence pair in (1), which constitutes a Sobel sequence (Sobel, 1970).

(1) a. *If kangaroos had no tails, they would topple over.*
   b. *If kangaroos had no tails but used crutches, they would not topple over.*

Lewis (1973) uses these examples to show that counterfactual conditionals do not allow antecedent strengthening, which would be predicted if they were interpreted as strict conditionals. As the set of worlds in which kangaroos have no tails should contain the set of worlds in which they also use crutches, (1a) and (1b) cannot both be true under a strict analysis. Lewis’s solution to the problem is variable strictness: Counterfactual conditionals (henceforth: counterfactuals) are interpreted by taking into account only the set of worlds which are sufficiently similar to the interpretation world. The argument is that the set of worlds being quantified over in (1a) differs from that in (1b) because *crutches* worlds are not among the most similar worlds – compared to the actual world – evoked by the antecedent *If kangaroos had no tails*. In (1b), meanwhile, the explicit mention of the *crutches* scenario in the antecedent forces evaluation relative to a more remote set of worlds, which changes the truth conditions.

As noted by von Fintel (2001), the problem with Lewis’ approach is that it does not account for the evolution of the surrounding discourse. If (1b) is uttered as a (possibly pedantic) reply to (1a), the truth of (1a) is called into question. Based on this observation, von Fintel introduces the notion of the *modal horizon*: He proposes that when (1b) is encountered, *crutches* worlds are added to the set of worlds that are accessible to the interlocutors in the discourse, and that the updated set of worlds, when used to interpret (1a), yields a false proposition.

In his analysis, von Fintel (2001) endows every counterfactual sentence with a context change

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potential, as formalized in (1). The formula states than when the counterfactual is interpreted, the modal horizon \( f \) – equivalent to the accessibility function – is updated with the set of worlds evoked by the antecedent \( \phi \), thus making these additional worlds accessible. The counterfactual is then interpreted using the updated modal horizon.

\[
\lambda w. f(w) \cup \{ w' : \forall w'' \in [\phi]^{f} : w' \leq_w w'' \} \tag{1}
\]

In the present paper, we consider the possibility that a proper discourse is not needed in order for the modal horizon to be expanded. Strictly speaking, someone who utters (1b) in response to (1a) must first expand their internal modal horizon by considering some relatively remote worlds, realize that (1a) is false in at least one of those worlds, and then inform the interlocutor of this fact. We can thus distinguish between an internal modal horizon corresponding to the set of worlds that a reader of (1a) or (1b) is able to access (or chooses to access) during interpretation, and an external modal horizon that is shared by the interlocutors in a discourse. Our present work is concerned only with the internal mental horizon that readers use when evaluating the truth of a counterfactual statement in isolation.

Below, we present the results of two truth-value judgment experiments that examine the circumstances under which readers become more or less likely to spontaneously expand their internal modal horizon in order to make ostensibly true counterfactuals false, or vice versa. In addition, we present a computational model of counterfactual evaluation that builds on an existing cognitive process model that explicitly links responses and their latencies, and that is largely able to reproduce the qualitative patterns in the empirical data. This type of computational modeling has been previously used in work on long-distance dependencies in sentence processing (Nicenboim and Vasishth, 2018), but has, to our knowledge, not been applied to truth-value judgment data.

1.1. Research questions and predictions

Our research questions can be summarized under three main points:

I. For counterfactuals that are ostensibly true or ostensibly false, how likely are speakers to expand their modal horizon in order to arrive at the opposite truth value? Do they prefer to go from true to false or from false to true? How much do speakers vary in this regard?

II. When the counterfactual in question already has a relatively broad modal horizon, that is, when the antecedent makes reference to relatively remote worlds, does further expansion become more or less likely?

III. What is the relationship between working memory capacity and spontaneous expansion of the modal horizon? If expansion involves cognitive effort, increased capacity should allow for more expansion.

\(^2\)See Gillies (2007) for a similar approach.

\(^3\)For a comprehensive review of previous experimental work on counterfactual processing, see Kulakova and Nieuwland (2016). A review of important research questions concerning conditionals more generally, and of the main theoretical approaches, can be found in Byrne and Johnson-Laird (2009).

\(^4\)We refer to a counterfactual as “ostensibly” true if it rings true “at face value”, that is, without expansion of the modal horizon to accommodate further assumptions. Taking the counterfactual “at face value” corresponds to what Kratzer (1979) calls the “stick-close-to-the-relevant-facts” strategy of interpretation. See our explanation of “plausibility” below.
With regard to the questions summarized under (I), it has been observed that humans apparently operate on a truth bias (Zuckerman et al., 1981; Levine et al., 1999), possibly due to the fact that most of the statements an average person is exposed to during their daily life are (considered) true (O’Sullivan et al., 1988). Truth bias is assumed by Truth-Default Theory (Levine, 2014), a general theory of deception detection. While most counterfactual statements are not made in order to actively deceive the interlocutor, an experience-based truth bias should plausibly extend to contexts in which statements may be false in the absence of malicious intent. Truth bias thus predicts that readers should be more likely to expand their modal horizon in order to make an ostensibly false counterfactual true (If kangaroos had no tails, they would not topple over) than to make an ostensibly true one false (If kangaroos had no tails, they would topple over). Despite this general predicted tendency, depending on their proneness to pedantry (Klecha, 2015) and/or tolerance of “pragmatic slack” and “loose talk” (Lasersohn, 1999; Lauer, 2012), readers may still vary in their willingness to accept a given counterfactual as true.

The intuition behind question (II) is that imagining more distant possible worlds should be more difficult. Assuming that the evaluation of counterfactual statements involves mental simulation (Van Hoeck et al., 2015), it is plausible that simulating more unfamiliar worlds – that is, worlds containing elements that do not correspond to everyday experience, such as kangaroos with crutches – should be more effortful than simulating worlds that are close to the actual world. It is thus predicted that readers should be more likely to assign the ostensible truth value to counterfactual statements with more elaborate antecedents, given that expanding the modal horizon should be dispreferred. A tendency to choose the ostensible truth value in sentences with complex antecedents may also interact with face-value plausibility, so that a truth bias effect may be reduced in complex sentences, in which deviation is costly.

Question (III) is based on the finding that higher working memory capacity is a predictor of more accurate language comprehension (Caplan and Waters, 2005), supports the resolution of long-distance dependencies (Nicenboim et al., 2016), and has an effect on language processing strategies, with high-capacity readers showing more commitment to their chosen interpretations (von der Malsburg and Vasishth, 2013). Readers with higher working memory capacity may engage with counterfactual statements more deeply, considering more possibilities, than readers with lower working memory capacity. Furthermore, given that mental simulation taxes working memory (Ferguson and Cane, 2015; Van Hoeck et al., 2015), high-capacity readers may be able to represent a higher number of possible worlds within their modal horizon compared to low-capacity readers. Assuming that deviation from the ostensible truth value of a given counterfactual is a signal that the modal horizon has been expanded, high-capacity readers should thus show more deviations than low-capacity readers.

2. Truth-value judgment studies

2.1. Experimental design, subjects and materials

We pre-registered our study with the Open Science Framework (Foster and Deardorff, 2017; https://osf.io/5xbjk). Our experiments employed a 2 × 2 design with the factors antecedent complexity (simple vs complex) and plausibility (plausible vs implausible), as shown below. Plausible sentences are intended to be ostensibly true while implausible counterfactuals are intended to be ostensibly false. Plausibility was assessed introspectively by the authors and two additional referees. Implausible sentences were derived from their plausible counterparts by either adding or removing a negation in the consequent. Antecedent complexity was manipulated...
by adding a conjunct in the complex version intended to invert the ostensible plausibility of the simple version. The presence of negation was counterbalanced across conditions, so that the same amount of negated consequents was encountered for each combination of the factor levels. Sentences were presented in German.

**Simple, Plausible**

a. If it was raining burning coals, there would be more forest fires.

**Simple, Implausible**

b. If it was raining burning coals, there would not be more forest fires.

**Complex, Plausible**

c. If it was raining burning coals and trees only grew underground, there would not be more forest fires.

**Complex, Implausible**

d. If it was raining burning coals and trees only grew underground, there would be more forest fires.

The experiments were run using the Linger software (Rohde, 2003). A set of German native speakers read the sentences, which were presented at once in their entirety, pressed the space bar, and then indicated with another key press whether they thought the sentence was **true** or **false**. Participants received either €7 or course credit as compensation.\(^5\) Reading times for the entire sentence and response times for the judgments were recorded. There was no time limit. In Experiment 1, a total of 42 participants read 32 counterfactual statements each, plus 64 filler sentences. Experimental sentences were presented according to a Latin-squares procedure, and were randomly intermixed with fillers at runtime. Fillers consisted mainly of philosophical quotes (“Everybody has stupid thoughts, but a wise person keeps them to themselves”) and predictions about the future (“In 2030, a manned mission to Mars’ moon Phobos will be launched”). Experiment 2 was an attempt to replicate the findings of Experiment 1 with a new set of 41 participants, using the same experimental materials and the same setup. Most participants completed an operation span test before the main experiment (Conway et al., 2005) (see also von der Malsburg and Vasishth, 2013; Nicenboim et al., 2016) to obtain a measure of their working memory capacity. We obtained this measure for 30 of the subjects in Experiment 1 and for all subjects in Experiment 2.

2.2. Data analysis

Even though we collected two latency measures during the experiment – reading time and judgment response time – we simplified our analyses by computing an aggregated measure we call evaluation time, which is the sum of reading time and judgment response time. The reasoning behind this simplification is that participants likely start reasoning about which truth value they want to assign well before the prompt is given, that is, while they are still reading the sentence. To accurately gauge processing difficulty, both latency measures should thus be taken into account. For our initial analysis, as opposed to analyzing the proportion of **true** and

\(^5\) A subset of seven participants in Experiment 1 was recruited from among personal acquaintances and received no compensation.
false answers across conditions, we analyzed the proportion of cases where the chosen truth value matches the ostensible truth value. This dependent measure is easier to interpret in terms of expansion of the modal horizon (match = no expansion, mismatch = expansion).

We analyzed evaluation times and the likelihood of choosing the ostensible truth value in R (R Core Team, 2019), using the brms package for Bayesian inference (Bürkner, 2017, 2018). All models were fitted using full variance-covariance matrices for the random effects (Barr et al., 2013). Lognormal distributions were fitted for evaluation times, and Bernoulli distributions with a logit link function were fitted for truth value choices. For the factor antecedent complexity, complex was coded as 1 and simple was coded as $-1$. For plausibility, plausible was coded as 1 and implausible was coded as $-1$. The interaction was coded as the product of the main effects. Centered, scaled sentence length in characters was entered into the evaluation time models to control for the length confound between simple and complex conditions. Normal(0.5) priors were used across all parameters for all models. LKJ priors (Lewandowski et al., 2009) with $v$ set to 2 were set for the variance-correlation matrices. Four MCMC chains with 2000 iterations each were run for each model. The first 1000 samples were discarded as warmup. $\hat{R}$ values close to 1 were used to monitor for any cases of non-convergence (Gelman and Rubin, 1992). All data and our analysis code will be released with the publication of this paper at https://osf.io/y42ve/.

2.3. Results

Tables 1 and 2 show evaluation times and proportions of chosen truth values by condition for the two experiments. In Experiment 1, participants were less likely to choose the ostensible truth value when the sentence was plausible rather than implausible ($\hat{\Delta} = -0.08$, CrI: $[-0.16, -0.01]$), and when the antecedent was complex rather than simple ($\hat{\Delta} = -0.19$, CrI: $[-0.3, -0.08]$). There was also an interaction ($\hat{\Delta} = -0.07$, CrI: $[-0.13, 0]$), due to complexity having a stronger negative effect on the likelihood of choosing the ostensible truth value in plausible sentences ($\hat{\Delta} = -0.26$, CrI: $[-0.39, -0.13]$) compared to implausible sentences ($\hat{\Delta} = -0.12$, CrI: $[-0.25, 0]$). Evaluation times also showed an interaction between complexity and plausibility ($\hat{\Delta} = 0.53$ s, CrI: $[0.17$ s, $0.9$ s]), such that antecedent complexity only increased the evaluation time for plausible sentences ($\hat{\Delta} = 0.92$ s, CrI: $[0.35$ s, $1.45$ s]).

In Experiment 2, participants were again less likely to choose the ostensible truth value for plausible compared to implausible sentences ($\hat{\Delta} = -0.07$, CrI: $[-0.14, -0.01]$), as well as for sentences with complex compared to simple antecedents ($\hat{\Delta} = -0.18$, CrI: $[-0.3, -0.06]$). As in Experiment 1, there was also an interaction ($\hat{\Delta} = -0.08$, CrI: $[-0.14, -0.02]$), due to a stronger effect of complexity in plausible sentences ($\hat{\Delta} = -0.26$, CrI: $[-0.39, -0.13]$) compared to implausible sentences ($\hat{\Delta} = -0.09$, CrI: $[-0.23, 0.04]$). Unlike in Experiment 1, there was a main effect of working memory capacity, such that higher capacity led to more deviations from the ostensible truth value ($\hat{\Delta} = 0.04$, CrI: $[0.01, 0.06]$). Evaluation times again showed an interaction between complexity and plausibility ($\hat{\Delta} = 0.41$ s, CrI: $[0.06$ s, $0.77$ s]), again due to antecedent complexity increasing evaluation time only for plausible sentences ($\hat{\Delta} = 0.83$ s, CrI: $[0.24$ s, $1.43$ s]).

For both experiments, there was no evidence of any interactions between the experimental manipulations and working memory capacity in any of the measures. Nevertheless, we are

Note that as the working memory predictor was scaled, the estimate represents the effect of increasing working memory capacity by one standard deviation.
interested in how much variability there is in the data with regards to how the manipulations affect each subject. Figure 1 plots the intercepts and slopes – population-level effect plus by-participant adjustments – for each participant on the probability scale. One interesting question to ask is whether all participants show an effect in the same direction, or whether there is evidence that some participants show no or even a reverse effect (Haaf and Rouder, 2017). As Figure 1 shows, we do not have enough data to answer this question for either the effect of plausibility or the plausibility × complexity interaction. For the main effect of complexity, however, we do have good evidence, especially in Experiment 1, that subjects consistently show reduced willingness to assign the ostensible truth value when the antecedent of the counterfactual is complex: As Figure 1 shows, the credible intervals for the complexity effect contain only negative values for almost all of the subjects.

<table>
<thead>
<tr>
<th>Plausibility</th>
<th>Complexity</th>
<th>LOW-CAPACITY PARTICIPANTS</th>
<th>HIGH-CAPACITY PARTICIPANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ET (s) p(TRUE) p(Ost)</td>
<td>ET (s) p(TRUE) p(Ost)</td>
</tr>
<tr>
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<td>simple</td>
<td>8.62 0.78 0.78</td>
<td>8.47 0.80 0.80</td>
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<td>10.44 0.54 0.54</td>
</tr>
<tr>
<td>implausible</td>
<td>simple</td>
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<td>8.81 0.18 0.82</td>
</tr>
<tr>
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<td>complex</td>
<td>9.32 0.27 0.73</td>
<td>8.92 0.30 0.70</td>
</tr>
<tr>
<td>filler</td>
<td>filler</td>
<td>8.47 0.45 —</td>
<td>8.55 0.48 —</td>
</tr>
</tbody>
</table>

Table 1: Mean evaluation time, proportion of true answers, and proportion of answers matching the ostensible truth value by condition and WMC group (Experiment 1). Evaluation time has been residualized against sentence length in characters.

<table>
<thead>
<tr>
<th>Plausibility</th>
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<th>HIGH-CAPACITY PARTICIPANTS</th>
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<tr>
<td></td>
<td></td>
<td>ET (s) p(TRUE) p(Ost)</td>
<td>ET (s) p(TRUE) p(Ost)</td>
</tr>
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<td>filler</td>
<td>filler</td>
<td>8.08 0.49 —</td>
<td>8.31 0.47 —</td>
</tr>
</tbody>
</table>

Table 2: Mean evaluation time, proportion of true answers, and proportion of answers matching the ostensible truth value by condition and WMC group (Experiment 2). Evaluation time has been residualized against sentence length in characters.

2.4. Discussion

Across experiments and conditions, participants chose the opposite of the ostensible truth value of the counterfactual about 27% of the time. There is thus evidence that readers routinely extend the set of evaluation worlds beyond the set of worlds evoked by the antecedent. Most of our predictions are not supported by the results. Participants did not show a truth bias, contrary to the prediction of Truth-Default Theory (Levine, 2014), but instead showed what

7The interpretation of the result crucially depends on one’s faith in the experimental materials, however. If our intuitive evaluation of the sentences’ plausibility does not match that of the average reader, the “ostensible” truth value is merely subjectively ostensible.
can be thought of as a falsity bias, so that ostensibly true (plausible) sentences were judged to be false more often than ostensibly false (implausible) sentences were judged to be true. Furthermore, increased complexity of the antecedent caused more rather than fewer deviations from the ostensible truth value, contrary to the prediction that expansion of the modal horizon should become more difficult, and therefore less likely, with complex antecedents. While there was an interaction between plausibility and complexity, the direction is unexpected and contrary to our predictions: Participants show an additional increase in deviations for complex, plausible sentences compared to complex, implausible sentences, casting further doubt on both truth bias and any connection between expansion effort and remoteness of the antecedent-evoked set of worlds. The only piece of evidence in favor of expansion being effortful is the observed increase in evaluation times for complex, plausible sentences, combined with the high proportion of

Figure 1: Estimated intercepts and effects of the experimental manipulations on the likelihood of choosing the ostensible truth value by subject and experiment. The average effect is shown at the bottom. Note that estimates are separately ordered by magnitude, so that rows do not map onto each other across plots.
inversions in this condition. While there is evidence from Experiment 2 that high-capacity participants deviate more often from the ostensible truth value, matching the prediction that expansion should be easier for readers with higher capacity, Experiment 1 yielded no evidence for such a pattern. With regard to the predicted interaction between working memory capacity and antecedent complexity, the data from both experiments are inconclusive: The credible intervals for the interaction both cross zero (Experiment 1: $\hat{\Delta} = -0.01$, CrI: $[-0.06, 0.05]$, Experiment 2: $\hat{\Delta} = -0.05$, CrI: $[-0.12, 0.01]$), so that the data are compatible with an effect in the predicted direction, an effect in the opposite direction, and with there being no effect at all (Alderson, 2004).

3. Computational modeling of the response process

The analysis presented in the previous section uses statistical models to draw inferences about the cognitive processes involved in interpreting counterfactual sentences. We now make an attempt to derive a plausible process model instead. A process model goes beyond the simple comparison of means across conditions and instead aims to directly account for the cognitive mechanisms that are recruited during interpretation.

We have suggested that the expansion of the modal horizon, which involves the mental simulation of possible worlds, is the process that creates measurable processing effort in our paradigm. This view, however, neglects the fact that the worlds in question also need to be evaluated in terms of whether the consequent holds in them. The variably strict view of counterfactual processing adopted by Lewis (1973) and von Fintel (2001) would dictate that whenever a world in which the consequent is false is encountered within the modal horizon, the entire counterfactual should be judged as false. Other models are possible. For instance, readers may take a counterfactual to be true if the consequent is true in the majority of worlds in the modal horizon. Such an approach can be formalized via the implicit addition of a default operator to the consequent (Ben-David and Ben-Eliyahu, 1994). Irrespective of how the final decision is made, the process involved in reaching a truth-value judgment can be viewed as one of evidence or information accumulation: The processor seeks information (in the form of possible worlds) in favor of answering either TRUE or FALSE, and once one of the options has accumulated enough evidence, the process is terminated and a response is produced.

One of the most well-known evidence-accumulation models for a two-choice task is the diffusion model of Ratcliff (1978). In the original task, a memory item has to be classified as being either recognized or not recognized. Evidence accumulation is controlled by the overlap in features between the recognition probe and potential memory targets from the study phase. Accumulation ends when either of two boundaries, “match” or “mismatch”, is reached. When the overlap between the probe and a target is high, the decision is directed towards the “match” boundary, yielding a positive recognition response. Conversely, when overlap is small, the decision is directed towards the “mismatch” boundary. Crucially, reaching the mismatch boundary for one particular memory item is not enough to trigger a negative recognition response to the probe: Only when all items have been classified as mismatches is the negative response triggered. The recognition process is thus self-terminating for matches (one match is enough) but exhaustive for mismatches (no recognition only if no items are matched).

Adapting the diffusion model to our truth-value judgment task, the variably strict view of counterfactual interpretation would dictate that FALSE responses are the result of self-termination – because one world in which the consequent does not hold is enough to disprove the counterfactual – while TRUE responses are the result of exhaustive processing, in which all antecedent
worlds under consideration have yielded TRUE for the consequent. Note that such an implementation naturally predicts a falsity rather than a truth bias, as seen in our data, given that, other things being equal, self-termination should occur more often than exhaustive processing. Furthermore, self-termination should also result in faster responses on average compared to exhaustive processing. However, looking at the evaluation time measure, the experimental conditions with a large proportion of FALSE answers do not show reduced evaluation times compared to those with a large proportion of TRUE answers. Indeed, a model fit to evaluation times with the given response as a predictor yields no evidence that FALSE answers were given any faster than TRUE answers ($\hat{A} = 0.01$ s, CrI: $[-0.2$ s, $0.24$ s]). We thus expect that the adaptation of Ratcliff’s (1978) model sketched here is not likely to yield an adequate fit to our data.

Another model that assumes gradual accumulation of evidence and directly links response preference to response speed is the lognormal race model of Rouder et al. (2015). In the lognormal race model, the possible responses themselves, rather than individual items in memory, accumulate evidence. The response for which the accumulation process finishes first is produced on a given experimental trial. The finishing times for each accumulator are log-normally distributed with mean $\mu$ and standard deviation $\sigma$. Effects of the experimental manipulations on finishing times can be estimated relatively straightforwardly by putting a slope on $\mu$ and fitting a linear regression, which yields an estimate of how much the corresponding accumulator speeds up or slows down in a given condition. The model assumes that the accumulators are independent and do not compete for mental resources. In terms of simulating mental worlds, the model would thus assume that the TRUE accumulator gathers evidence in favor of the consequent being true, while the FALSE accumulator simultaneously gathers evidence in favor of the consequent being false. This assumption does not rule out the possibility that the same worlds are being accessed during the process: For a given world $w$, the evidence in favor of TRUE is incremented if the consequent is true in $w$, otherwise the evidence in favor of FALSE is incremented.

While a variety of cognitive process models exist that could potentially be used to account for the processing of counterfactual sentences, the lognormal race model strikes us as intuitively plausible and relatively easy to implement. Compared to the more classical approach of analyzing responses and response latencies separately, it offers the advantage of taking into account both sources of information within one and the same trial. Moreover, the lognormal race model also offers a potentially more insightful view of between-participant variability: Rather than preferring to deviate or not deviate from the ostensible truth value of a given sentence, participants may vary in their underlying propensity to answer TRUE or FALSE, represented by faster or slower mean finishing times of the respective accumulators for a given participant. The model thus allows for a more straightforward evaluation of the claim that TRUE judgments should be preferred over FALSE judgments by most readers.

3.1. Implementation of the lognormal race model

We implemented the lognormal race model in Stan (Stan Development Team, 2018). Data from Experiment 1 and 2 were pooled for this analysis. As before, we included antecedent complexity (simple = $-1$, complex = 1) and plausibility (implausible = $-1$, plausible = 1) as predictors. Four MCMC chains with 4000 iterations each (with 2000 warmup iterations) were run. The model code with prior settings is given in the on-line supplementary materials at https://osf.io/y42ve/. Separate coefficients were estimated for all effects of interest for the TRUE and FALSE accumulators. Separate standard deviations were also assumed for the
accumulators. If FALSE answers are the result of self-termination (see above), one would expect FALSE answers to show more variable response times than TRUE answers, as self-termination may occur at any moment during processing when a FALSE world is found. Besides main effects of the experimental manipulations and their interaction, coefficients were also estimated for the presence versus absence of negation (no negation = −1, negation = 1), which was manipulated as a cross-balanced between-items factor, as well as for working memory capacity and its interactions with antecedent complexity, plausibility, their two-way-interaction, and negation. For antecedent complexity and plausibility, the model also contains interactions with trial position in the experiment (first half = −1, second half = 1) to see if the experimental manipulations have different effects at the beginning of the experiment compared to the end. By-participants and by-item random effects were added to intercepts and slopes where appropriate. Instead of including a slope for sentence length in characters on the log scale, the lognormal race model contains a shift estimate on the original millisecond scale (Rouder, 2005). The shift parameter is intended to account for “more peripheral aspects of processing such as encoding stimuli or motor execution of responses” (Rouder, 2005: p. 377). Our goal was to arrive at an estimate of the time it takes to evaluate the truth of the counterfactual by factoring out as much as possible the more low-level aspects of word identification, structure assignment, and so forth. The shift is composed of an intercept and a slope for the number of characters in the sentence, both with estimated by-participant random effects. Fillers contribute to the estimate of each accumulator’s intercept, as well as to the estimates for each subject’s shift intercept and slope, thus yielding better estimates for these parameters. Compared to fitting separate regression models for TRUE and FALSE answers, the lognormal race model has an additional advantage: When a FALSE answer is given on a trial with some latency $x + \text{shift}$, not only do we learn that $x$ must be the FALSE accumulator’s finishing time on that particular trial, but also that the latency of the TRUE accumulator must have been larger than $x$, as the accumulator with the shortest latency always wins.

3.2. Results

Figures 2 and 3 show the distributions of finishing times for the TRUE and FALSE accumulators by working memory group (high versus low capacity, median cut). The plots show the distribution of the means for each observation in the data set, calculated across 8000 post-warmup draws from the posterior predictive distribution of the model. Table 3 compares the data generated by the model with the original data. As the numbers show, the model is mostly able to recover the qualitative aspects of the data in both response proportions and evaluation times, even though it strongly underestimates the proportion of TRUE responses to filler items and simple, plausible sentences.

The estimated mean finishing times for experimental sentences are 13.6 s (CrI: [12 s, 15.48 s]) for the TRUE accumulator and 12.23 s (CrI: [11.08 s, 13.5 s]) for the FALSE accumulator. Plausibility speeds up the TRUE accumulator (Δ = −7.25 s, CrI: [−8.9 s, −5.63 s]) and simultaneously slows down the FALSE accumulator (Δ = 5.38 s, CrI: [4.14 s, 6.66 s]), resulting in a higher proportion

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8For instance, negation was not freely manipulated within items and thus has no by-item adjustment, while working memory capacity has no by-participant adjustment.

9Note that this also results in the estimated mean finishing time for each accumulator being longer than the respective observed mean finishing time, because finishing times are only observable when the accumulator finishes more quickly than its competitor and otherwise remain latent.
of **TRUE** answers for plausible compared to implausible sentences. Antecedent complexity slows down **TRUE** \( \hat{\Delta} = 3.31 \text{ s}, \text{ CrI: [2.41 s, 4.19 s]} \), but there is not much evidence that it slows down **FALSE** \( \hat{\Delta} = 0.47 \text{ s}, \text{ CrI: [-0.4 s, 1.3 s]} \), thus more **FALSE** answers occur in complex sentences. A plausibility × complexity interaction results in a super-additive slowdown on **TRUE** \( \hat{\Delta} = 3.08 \text{ s}, \text{ CrI: [1.59 s, 4.6 s]} \) and a corresponding speedup on **FALSE** \( \hat{\Delta} = -1.96 \text{ s}, \text{ CrI: [-3.58 s, -0.4 s]} \) in complex, plausible sentences. The result is an asymmetrical pattern with more **FALSE** answers in complex, plausible sentences – meaning more deviations – but fewer **FALSE** answers in complex, implausible sentences – also meaning more deviations. The presence of negation in the consequent slows down **FALSE** \( \hat{\Delta} = 1.6 \text{ s}, \text{ CrI: [0.18 s, 3.03 s]} \), resulting in more **TRUE** answers across all conditions for negated sentences.

Working memory speeds up **FALSE** \( \hat{\Delta} = -0.42 \text{ s}, \text{ CrI: [-0.74 s, -0.07 s]} \), so that high-capacity participants give more **FALSE** answers across all conditions. There is also evidence of an interaction between working memory and plausibility, such that high-capacity participants’ speedup for the **FALSE** accumulator is attenuated in plausible sentences \( \hat{\Delta} = 0.6 \text{ s}, \text{ CrI: [-0.08 s, 1.28 s]} \); this means that high-capacity participants are especially likely to respond **FALSE** to implausible sentences. Both accumulators show a speedup in the second half of the experiment **TRUE** \( \hat{\Delta} = -1.4 \text{ s}, \text{ CrI: [-1.86 s, -0.94 s]} \), **FALSE** \( \hat{\Delta} = -1.14 \text{ s}, \text{ CrI: [-1.52 s, -0.76 s]} \), indicating that responses were given faster overall.

![Figure 2](image_url)

**Figure 2:** Predicted finishing times of **TRUE** and **FALSE** accumulators by condition for low-capacity participants. Vertical lines mark predicted mean finishing times.

### 3.3. Between-participant variability

Between-participant variability occurs within the model at the levels of the accumulator intercepts as well as the slopes. Variability at the level of the intercepts is shown in Figure 4 for a subset of 11 participants. As the figure shows, there are some participants for which the overall mean finishing time of the **TRUE** accumulator is faster than that of the **FALSE** accumulator, but for the majority of subjects the **FALSE** accumulator is faster.

Figure 5 shows between-participant variability in the slope estimates for plausibility, complexity, and their interaction for the **TRUE** accumulator. Participants mostly show consistent effects of the manipulations that are in line with the estimated population-level effects, with only
Figure 3: Predicted finishing times of TRUE and FALSE accumulators by condition for high-capacity participants. Vertical lines mark predicted mean finishing times.

Table 3: Comparison of empirical and model-generated mean evaluation time and proportion of TRUE answers by condition.

<table>
<thead>
<tr>
<th>Plausibility</th>
<th>Complexity</th>
<th>p(TRUE)</th>
<th>$\overline{ET}$ (s)</th>
<th>DATA</th>
<th>MODEL</th>
<th>DATA</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>plausible</td>
<td>simple</td>
<td>0.81</td>
<td>8.28</td>
<td>0.66</td>
<td>8.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plausible</td>
<td>complex</td>
<td>0.57</td>
<td>9.82</td>
<td>0.51</td>
<td>9.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>implausible</td>
<td>simple</td>
<td>0.19</td>
<td>8.87</td>
<td>0.21</td>
<td>8.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>implausible</td>
<td>complex</td>
<td>0.28</td>
<td>9.07</td>
<td>0.25</td>
<td>9.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filler</td>
<td>filler</td>
<td>0.47</td>
<td>8.34</td>
<td>0.32</td>
<td>8.36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4: Estimated finishing time intercepts of true and false accumulators for a subset of 11 subjects. Green = true, red = false. Note that estimates are separately ordered by magnitude, so that rows do not map onto each other across figures.

Figure 5: Estimated effects on finishing time of true accumulator for a subset of 11 subjects. Turquoise = plausibility, purple = complexity, yellow = plausibility × complexity interaction. Note that estimates are separately ordered by magnitude, so that rows do not map onto each other across figures.

and Vasishth, 2018). For instance, if plausibility is assumed to affect only the true accumulator while the false accumulator has a fixed mean finishing time across conditions, the race assumption should still allow us to recover the qualitative pattern in the data: When the true accumulator is slowed down in implausible sentences, the false accumulator automatically becomes more likely to win due to the underlying race assumption. Analogous predictions can be made for all other effects in the model. The question is whether a model in which one of the accumulators acts as a “default” fits both the response and the latency profile of the data as well as the more complex model does.

We implemented both a true-default and a false-default model by removing all parameters on the respective accumulator except the intercept, adjustments by-participant and by-item random effects, and coefficients for negation and trial position in the experiment. The latter two parameters were kept because negation could plausibly delay the assignment of a default truth value while hastened responses in later parts of the experiment could also occur for default judgments. Model comparison was carried out using the loo package (Vehtari et al., 2019, 2017), which performs approximate leave-one-out cross-validation using Pareto-smoothed importance
Figure 6: Estimated effects on finishing time of FALSE accumulator for a subset of 11 subjects. Turquoise = plausibility, purple = complexity, yellow = plausibility × complexity interaction. Note that estimates are separately ordered by magnitude, so that rows do not map onto each other across figures.

Results of the model comparison show that the FALSE-default model outperforms the TRUE-default model in its predictive accuracy (Δelpd = 102.9, SE = 32.5). The original model featuring the entire range of parameters outperforms both the TRUE-default model (Δelpd = 354.7, SE = 25.9) and the FALSE-default model (Δelpd = 251.8, SE = 20.3). The assumption of additional parameters in the original model is thus justifiable based on the increase in predictive fit. However, should one have strong theoretical reasons to assume a default response, the default is more likely to be FALSE than TRUE based on our model and data.

3.5. Discussion of the modeling results

Besides making the assumptions about cognitive processes involved in the interpretation of counterfactual sentences explicit, the implementation of the lognormal race model yields several insights that go beyond the conclusions drawn from the simple linear modeling approach. The first insight is that the FALSE accumulator gathers evidence more quickly than the TRUE accumulator overall, which results in an overall falsity bias. The second insight is that antecedent complexity mainly affects the rate of accumulation of the TRUE accumulator while plausibility has a nearly symmetrical effect on both accumulators. This pattern can be interpreted as showing that the antecedents of plausible sentences tend to evoked worlds in which the consequent is true while those of implausible sentences tend to evoked worlds in which the consequent is false, as intended by the manipulation. Meanwhile, adding complexity to the antecedent in the form of additional restrictions on the evoked worlds appears to result in fewer TRUE worlds being added to the modal horizon. This may signal that as the modal horizon – that is, the sphere of accessible worlds – expands, opportunities for falsification keep occurring at the same rate and require the same amount of effort, while more and more effort is required for verification. Such a conclusion fits well with the assumption that the interpretation of counterfactuals is, at its core, strict (Lewis, 1973) and that most counterfactuals are, in truth, false if one reasons deeply about them (Hájek, 2014).
Further conclusions from the computational model concern effects of working memory capacity, negation, and the question of whether there is a “default” answer in truth-value judgments of counterfactuals. With regard to working memory, it appears that high-capacity participants have easier access to FALSE worlds, especially in implausible sentences, in which they are naturally evoked by the antecedent. One interpretation of the finding is that participants with high working memory capacity allocate their mental resources more efficiently, allowing them to focus on falsifying the counterfactual as a time-saving strategy. Meanwhile, negation slows down the generation of FALSE responses, for which there are two plausible reasons: One is that responding FALSE to a negated sentence results in an implicit double negation, which may cause readers to doubt their judgment (cf. “The sentence Cats are not animals is false”). The other possible reason is that responding FALSE is, in some sense, the default, and that negation introduces uncertainty as to whether the default judgment is correct. That responding FALSE is more likely as to be the default than responding TRUE is also supported by the model comparison results, where the FALSE-default model outperformed the TRUE-default model in terms of predictive accuracy. However, as the “full” model yields even better predictive performance, it appears that a possible default preference for FALSE in the judgment of counterfactuals can be affected by manipulations of plausibility and antecedent complexity.

4. General discussion

Through experimentation and computational modeling, we have been able to shed new light on the semantic processing of counterfactual statements such as If kangaroos had no tails but used crutches, they would not topple over. The first, possibly trivial and possibly most important, insight is that there is no absolute consensus between readers as to what the truth value of a given counterfactual should be. The existence of such variability is often overlooked or at least relegated to footnote status in formal accounts of counterfactual interpretation. We have argued that between-participant variability is naturally accounted for by assuming that individual readers may be more or less likely to change their internal modal horizon to contain worlds that result in a flip of the ostensible truth value.

Despite disagreements between language users, there is also a striking amount of consistency in the sense that manipulations of plausibility and antecedent complexity tend to have, in the mean, comparable effects: In our experiments, sentences with ostensibly plausible antecedent-consequent combinations were judged to be TRUE more often than those with ostensibly implausible combinations. Furthermore, participants largely pattern alike in their asymmetrical response to antecedent complexity conditioned on plausibility: Increased antecedent complexity tends to lead to more deviations from the ostensible truth value in plausible compared to implausible sentences. This pattern can be seen as supporting the notion that the interpretation of counterfactuals is strict, as assumed by Lewis (1973), and that most counterfactuals are false Hájek (2014): It is difficult to prove and easy to disprove them, especially when they are based on outlandish premises.

We have also found evidence that implicates working memory in counterfactual processing, which is expected if mental simulation of possible worlds is involved, and matches previous evidence from the processing literature (Ferguson and Cane, 2015). Based on the finding that high-capacity participants are more likely to give FALSE judgments for counterfactuals, and especially in implausible cases, our preliminary conclusion is that these individuals may strategically allocate mental resources to falsification, which increases their efficiency at performing the task.
Finally, we have demonstrated that fitting cognitive process models to empirical data potentially results in a deeper understanding of the theoretical implications by bridging the gap between formal accounts of a phenomenon and the way actual human beings behave when confronted with language. To our minds, the lognormal race model of Rouder et al. (2015) is a natural candidate in this regard: Accumulation of evidence is implied by possible-world semantics and can be plausibly mapped onto evaluating the consequent in a set of antecedent-evoked worlds. Furthermore, the model establishes a direct link between a response and the speed with which it is given, thus linking effort and response preference in a transparent way. The model is mostly able to reproduce the patterns seen in our data, thus validating the approach, though the fit is by no means perfect. This, however, is only to be expected, given that

\[...\] it would be very remarkable if any system existing in the real world could be exactly represented by any simple model. However, cunningly chosen parsimonious models often do provide remarkably useful approximations. \[...\] The only question of interest is “Is the model illuminating and useful?” (Box, 1979: p. 202–203)

We would argue that the lognormal race model as applied to truth-value judgments fulfills both conditions and should be applied to other types of sentences in future work.

4.1. A non-exhaustive list of caveats

Several caveats are in order. We have assembled them here in the form of a non-exhaustive list of bullet points for ease of reference.

- When looking at the entire experiment, we see a falsity bias even for filler sentences. It is possible that because participants encountered a large number of implausible fillers, they may have developed the falsity bias observed for experimental sentences during the experiment. While our analysis revealed no interactions between early versus late trials and our manipulations, it is possible that these interactions are more complex than our model can account for (Baayen et al., 2017). Furthermore, when participants are explicitly asked to judge whether a given sentence is true or false, any truth bias present in everyday language use may be suspended, and thus our findings may not generalize to more naturalistic settings.

- Intuitively, the discourses A-B and A’-B’ below are not entirely parallel, though up until now we have been implicitly treating them as a minimal pair:
  
  A. If kangaroos had no tails, they would topple over.
  B. Not true! If kangaroos had no tails but used crutches, they would not topple over.

  A’. If kangaroos had no tails, they would not topple over.
  B’. True! If kangaroos had no tails but used crutches, they would not topple over.

In A-B, the interlocutor expands the modal horizon to retroactively render the speaker’s utterance false. By contrast, in A’-B’, the interlocutor “saves” the speaker’s ostensibly false utterance by changing the modal horizon. “Expansion” is something of a misnomer in the A’-B’ case: Here, the modal horizon must not contain any not-crutches worlds after the update, so that worlds are actively being removed from the initial scope of the accessibility function. In A-B, not-crutches worlds can safely remain within the scope.
of the accessibility function: As long as there is an accessible subset of crutches worlds, strictness guarantees the falsity of the initial utterance. The asymmetry casts doubt on the underlying assumption that the same processes are responsible for true-to-false and false-to-true changes, as it may be that elimination of worlds from the modal horizon is a separate mechanism with a discernible cost.

- We have chosen to adopt a possible world semantics for counterfactuals (Lewis, 1973) in combination with von Fintel’s (2001) notion of a dynamic modal horizon as the theoretical starting point for our investigation. Both of these accounts have been criticized in the literature. Ciardelli et al. (2018) present experimental evidence from counterfactuals with disjunctive antecedents that they argue to be incompatible with the notion of a similarity-based accessibility function as employed by both Lewis and von Fintel. Moss (2012) argues that the relevant properties of Sobel sequences that motivate the modal horizon assumption can be accounted for by pragmatic factors governing the felicity of utterances in a context. We remain agnostic as to how our findings can be accounted for under alternative approaches to counterfactual interpretation, but note that deviations from the ostensible truth value of a sentence are in need of explanation.

5. Conclusion

Our experimental studies were not concerned so much with the truth conditions of counterfactuals, but rather with what Stalnaker (1986) calls their “belief conditions”: We did not ask when counterfactuals are true,\(^\text{10}\) but under which conditions language users accept them as true, and with how their judgments are reached. In essence, we assume that subjects conduct a Ramsey test (Ramsey, 1931; Stalnaker, 1986) by temporarily assuming that the antecedent is true, entering into the most accessible possible worlds evoked by this assumption, and evaluating the truth of the consequent in those worlds. Our results suggest that for counterfactuals with complex antecedents, subjects follow what Kratzer (1979) calls the “skeptical” strategy, which yields strict interpretations: If they can find evaluation worlds which render the counterfactual false, they appear to do so. When subjects choose what we call the ostensible truth value of the counterfactual, they are instead following the “keep-close-to-the-relevant-facts” strategy: They do not expand their internal modal horizon beyond what the antecedent necessitates.

References


\(^{10}\)For a recent discussion of counterfactual truth values, see von Prince (2019).


Adverbial responses to quantified utterances
Jérémy PASQUEREAU — University of Surrey, UK.

Abstract. This paper establishes a new empirical generalization concerning the interpretation of (Bare) Adverbial Responses (BARs) in English and supplements previous ellipsis-based accounts of BARs (Kramer and Rawlins, 2011) with an analysis taken from an account of polar responses presented in Pasquereau (in press).

Keywords: adverbial responses, negative questions, negation-movement.

1. Introduction

A question as in (1A) can be answered by a full clause (1B1/2) or by just the bare adverb of course (2B1/2).

(1) A: Does John show up for work?
   B1: Of course, he shows up for work!
   B2: Of course, he doesn’t show up for work!

As reported in previous work on Bare Adverbial Responses (BARs; Kramer and Rawlins 2010, 2011, 2012; Kroll and Roberts 2019), when the question is positive (2), the bare adverb of course asserts the (positive) question nucleus—it agrees with it in Roelofsen and Farkas (2014)’s terminology—and the bare adverb followed by not asserts the negative answer—it reverses it. When the question is negative however, both responses have the same meaning: John did not try the food at all, of course. This was dubbed ‘negative neutralization’ and analyzed in Kramer and Rawlins (2010, 2011, 2012) (reviewed later).

(3) A: Does John not show up for work?
   B1: Of course! (= John does not show up for work)
   B2: Of course not! (= John does not show up for work)

The puzzle this paper is about is illustrated by (4) from Holmberg (2013: ex. 49). If the adverb sometimes is inserted to the left of negation, negative neutralization disappears: of course means that indeed sometimes John does not show up for work, whereas of course not conveys that John always shows up for work. In the previous literature, this contrast between the interpretation of of course not in response to (3A) and (4A) is analyzed as resulting from a difference in the types of negation involved in the respective questions. However, I explore an account in which negation is the same in (3A) and (4A), but the difference is that it is in the scope of a scope-bearing operator in (4A) which triggers the reverse interpretation of of course not.

(4) A: Does John sometimes not show up for work?
   B1: Of course! (= John sometimes does not show up for work)
   B2: Of course not! (= John always shows up for work)

1I would like to thank Rajesh Bhatt for helpful comments on previous versions of this work. Thank are also due to Matthew Baerman, Oliver Bond, Michael Franjieh, Steven Kaye, Greville Corbett, Helen Sims Williams for judgments about English and Marina Chumakina, and Nadezhda Christopher for judgments about Russian.

Following previous analyses of bare adverbial responses, I propose that BARs are sensitive to the polarity of their antecedent. However, I show that, like other responses involving ellipsis (e.g. embedded non in French; Pasquereau 2018) BARS are sensitive to the scope of negation with respect to other scope-bearing operators in their antecedent. Thus, to explain the contrast in interpretation between (3B2) and (4B2), I explore the intuition (already formulated in Roelofsen and Farkas, 2014) that a sentence is negative when negation is the highest scope-bearing operator and not negative otherwise, for instance when negation is outsourced by a quantifier. Following this intuition, the interpretation of of course not can be characterized by the following generalization: in response to a question, of course not conveys agree when the question nucleus is negative as in (3); however, when it is not negative as in (2) or (4; because the highest-scope bearing operator in the question nucleus is not negation), of course not must convey reverse. Crucially, my account does not rely on negation being clausal negation in (3) and not being clausal negation in (4) (pace Kramer and Rawlins, 2010, 2011, 2012; Holmberg, 2013; Kroll and Roberts, 2019).

I propose to supplement previous ellipsis-based analyses of BARs with the ideas developed in Pasquereau (in press) for a similar pattern involving embedded Polar Response Particles (a.k.a. yes/no particles) in French. In this analysis, BARs involve an elided constituent and the polarity head (in the elided constituent) must move to the head that the adverb is adjoined to. For instance, the idea is that in of course not, not spells out an interpreted negation, but not is sensitive to whether the nucleus of the question it responds to is itself negative or positive. In cases like (3), this leads to there being still only one negation in the response. However in (4), interpreting negation in situ or where not appears yields different truth-conditions. In this case only, a covert polarity head can be inserted, moved, and realized as not: thus yielding a response with two interpreted negations, yielding the reverse reading.

Section 2 reviews how previous approaches have accounted for simple cases of BARs. In particular, I discuss accounts which explicitly assume that examples like (4) involve cases of ‘low’ or ‘constituent’ negation and I argue that making the generalization hinge on the syntactic position of negation runs into issues. In particular, section 3 shows that (4) is only one type of examples producing the contrast of interest and that the generalization describing the appearance/disappearance of negative neutralization is in fact much wider. Previous ellipsis accounts of BARs are not incompatible with the new data this paper aims to account for, as long as they are supplemented with a few assumptions independently needed to account for a similar pattern (involving French yes/no particles developed in Pasquereau, in press). I show how it accounts for the new English data in section 4 building off of the specific account in Kramer and Rawlins 2011. Section 5 discusses how the analysis fares with high-negation polar questions and reversing responses to negative questions. Section 6 concludes.

2. Background

In order to show how proposed ellipsis-based accounts of BARs fare with respect to the data in (3) and (4), I start with an overview of this approach by taking the particular account developed by Kramer and Rawlins (2011) for the sake of concreteness (though nothing hinges on the particular details of this account). I then discuss extensions of this account according to the hypothesis that negation is clausal negation or not. I argue that there is good reason to account for the contrast in (3) and (4) by appealing to negation being clausal negation.
In this section, I show how Kramer and Rawlins’ analysis captures most of the behavior of bare adverbials except the contrast due to the presence of a quantifying element with respect to negation. I also use the specific examples they use to illustrate their proposal. I start with the simplest case: a positive response to a positive question (5). The idea is that the bare adverbial response of course stands for an entire sentence and is derived from it via ellipsis, much like e.g. fragment answers to constituent questions. Kramer and Rawlins argue that BARs are adverbs adjoined to a high $\Sigma P$. The head $\Sigma$ can have an $[E]$ feature (Merchant, 2001) which licenses ellipsis of its TP complement (following Laka, 1990). In that sense, they resemble fragment answers. (Note that the adverb of course does not interact at all with the $\Sigma P$ it is adjoined to.)

(5) **Positive Q, of course answer**
A: Is Alfonso going to the party? B: Of course (= of course he is going to the party).

When a question is negative (6), whether the response is of course or of course not, the meaning is the same: the BAR conveys agree. This is the negative neutralization phenomenon.

(6) A: Is Alfonso not coming to the party?
   a. B1: Of course = (of course he is not coming to the party).
   b. B2: Of course not = (of course he is not coming to the party).

If the answer to (6A), also in (7), is of course, the $[E]$ feature makes sure that TP is identical to (i.e. e-given) its antecedent—that it contains interpretable negation among other things—and TP can be elided (represented by a frame).

(7) **Negative Q, of course answer (agreement)**
A: Is Alfonso not going to the party? B: Of course (= of course he is not going . . . ).
B: $[\Sigma P$ of course $[\Sigma P [TP$ Alfonso $\Sigma [iNeg]$ is going to the party $]]]$.}

If the answer to (6A), also in (8), is of course not, as with of course, the $[E]$ feature ensures that TP is identical to its antecedent which means that, among other things, TP must contain an interpretable negation. Kramer and Rawlins assume that not spells out a $\Sigma$ head which has a negative feature value and which has entered into a negative concord dependency. Since there can be only one interpretable feature in such a dependency, the feature on high $\Sigma$ must be uninterpretable. The $[uNeg]$ feature on high $\Sigma$ establishes a concord chain with $[iNeg]$ on low $\Sigma$. Because the TP complement of $\Sigma$ is e-given, it can be elided. The negative neutralization
facts are derived because the NEG feature that no contributes is not interpreted; thus the LF in (7) and (8) have the same interpretation.

(8) **Negative Q, of course not answer (agreement)**
A: Is Alfonso not going to the party? B: Of course not (= of course he is not going . . . ).
B: [TP of course [TP $\Sigma_{\text{INEG}, e}$] [$\text{TP he } \Sigma_{\text{INEG}}$ is going to the party ] ] ].

The last configuration is one where the question is positive but the answer is negative (9). Because not is used, it must enter in a concord dependency, but the semantic identity condition prevents $\Sigma_{\text{INEG}}$ from appearing in the ellipsis site because the antecedent is positive. Kramer and Rawlins propose that in this configuration, $\Sigma_{\text{INeg}}$ is forced higher in the chain, on high $\Sigma$.

(9) **Positive Q, of course not answer**
Is Alfonso going to the party? Of course not (= of course he is not going to the party).
B: [TP of course [TP $\Sigma_{\text{INEG}, e}$] [$\text{TP he } \Sigma_{\text{INEG}}$ is going to the party ] ] ].

2.1. Clausal negation hypothesis

Let us now talk about the contrast in (3) and (4) where a quantifying adverb has scope over negation. In the next section, I discuss a variant of the Kramer and Rawlins type of account where negation is assumed to be constituent negation, but before that, I would like to discuss an extension of Kramer and Rawlins’ extent where negation is usual clausal negation.

Accordingly, one direct way the positive BAR to the question in (4) could be modelled in Kramer and Rawlins’s account is as in (10) where the adverb sometimes is adjoined above clausal negation. Ellipsis is licensed as TP is e-given, the agree reading is correctly predicted.

(10) **Negative+Quant Q, of course answer**
A: Does John sometimes not show up for work?
B: Of course. (= of course John sometimes does not show up for work )
[TP of course [TP $\Sigma_{\text{E}}$] [$\text{TP he }$ sometimes [$\text{TP } \Sigma_{\text{INEG}}$ [VP show up for work ] ] ] ] ].

Correctly predicted reading: of course John sometimes does not show up for work

Trouble comes with negative BARs to such questions. In case where the response is of course not, not spells out a negatively valued $\Sigma$ participating in negative concord, however since a negative concord chain can only have one interpretable negative feature and since the interpretable negative feature is already on clausal Neg (required for e-givenness), the feature on high $\Sigma$ must be uninterpretable, exactly parallel to the simple negative question above. As a result only the negation below sometimes is interpreted and the predicted reading is the agree reading instead of the attested reverse reading. Just as with the simple cases, Kramer and Rawlins’ account predicts negative neutralization of the two responses of course and of course not.

(11) **Negative+Quant Q, of course not answer**
Does John sometimes not show up for work?
Of course not (= of course John does not sometimes not show up for work )
[TP of course [TP $\Sigma_{\text{INEG}, e}$] [$\text{TP he }$ sometimes [$\text{TP } \Sigma_{\text{INEG}}$ [VP show . . . work ] ] ] ] ]].
Predicted reading: of course John sometimes does not show up for work

The issue is that the formation of a negative concord dependency between \( \Sigma \) and Neg is not sensitive to the presence of the intervening adverb *sometimes*. In what follows, I build on Kramer and Rawlins’ account to do precisely that but before I discuss a type of account proposed in the literature where negation below *sometimes* is assumed to be constituent negation.

2.2. Low negation hypothesis

Accounts explicitly discussing examples like (3) and (4) assume that the *not* in the question in (4) (but not in 3) is an occurrence of ‘low negation’—‘predicate negation’ in Krifka (2013)’s proform account or vP/VP level constituent negation in ellipsis account. According to these analyses, a positive BAR has the syntax in (12). The idea is that both \( \Sigma \) heads, not being valued negatively, do not contribute to the truth-conditions of the sentence, which is then correctly predicted to convey *agree*, i.e. *of course John sometimes doesn’t show up for work*.

(12) **Negative+Quant Q, of course answer**
A: Does John sometimes not show up for work? B: Of course = (of course John sometimes does not show up for work).
\[
[\Sigma \text{ of course } [\Sigma \text{ he } [\Sigma \text{ sometimes } [\text{ VP not show up for work } ] ] ] ]].
\]

When the answer is a negative BAR, *not* spells out a negatively valued high \( \Sigma \) which enters in a concord dependency and since low \( \Sigma \) must be uninterpretable (because of e-givenness), high \( \Sigma \) is interpretable. The correctly predicted meaning is *reverse*, i.e. *it is not the case that John sometimes does not show up for work*.

(13) **Negative+Quant Q, of course not answer**
A: Does John sometimes not show up for work? B: Of course not = (of course John always shows up for work).
\[
[\Sigma \text{ of course } [\Sigma \text{ [E, INEG] he } [\Sigma \text{ [sometimes [VP not show up ] ] ] }]]].
\]

The structures discussed in the literature illustrating this contrast are all of the shape ‘adverb negation’, and while I think it is plausible that these structures may (at least sometimes) involve constituent negation, I show in what follows that the contrast exemplified in these structures crucially does not rely on negation always appearing in a particular syntactic position. This is one of the main features of the ‘analytical modification’ I propose in this paper.

There are three arguments that this contrast does not rely on the lower syntactic position of negation. First, the assumption that the occurrence of the adverb *sometimes* to the left of *not* diagnoses constituent negation runs into problems with examples like (14a) where *not* cannot be a case of constituent negation because it appears in reduced form on inflected *has*. Note for later that if the inflected auxiliary *has* is in T as standardly assumed, then two things follow: (i) it is possible that *does* in (13b) is also in T supporting clausal negation, and (ii) *sometimes* must occur in a projection above T.
(14)  a. John, sometimes, hasn’t shown up for work.
    b. John, sometimes, does not show up for work.

Secondly, the question in (4) in other languages is possible with usual instances of negation
(15)  a. A: Est -ce que Jean ne va parfois pas au travail ? (French)
    is it that Jean NEG goes sometimes NEG to work
    b. A: A čto, Ivan inogda ne priežžaet na rabotu? (Russian)
    so what Ivan sometimes NEG goes to work

Thirdly, the contrast attributed to a lower position of negation in English is the result of a much
wider generalization involving the semantic scope of negation with respect to scope-bearing
operators in any syntactic position (Pasquereau, in press). I turn to this in the next section.

3. Generalization

The contrast of interest in this paper relies on the scope of negation with respect to other scope-
bearing elements (Pasquereau 2017, 2018, in press; Kroll and Roberts 2019), however unlike
most previous work on this topic (Holmberg, 2011; Thoms, 2012; Krifka, 2013, Kroll and
Roberts, 2019), I show that this contrast does not stem from negation being in a special lower
syntactic position. The contrast does not only appear with adverbs to the left of negation but
also with adverbs in other positions. For instance, in (16) where sometimes appear at the end of
the question or at the beginning of a rising declarative in (17; cf the rising declarative without
the adverb in 18), the negative BAR has to convey a reverse answer.

(16)  Does John not show up for work sometimes?
    a. Of course, *he’s always there / he does not show up sometimes.
    b. Of course not, he’s always there / *he does not show up sometimes.

(17)  Sometimes John does not show up for work ?
    a. Of course! (= Sometimes John does not show up for work)
    b. Of course not! (=not(Sometimes John does not show up for work))

(18)  John does not show up for work ?
    a. Of course! (= John does not show up for work)
    b. Of course not! (= John does not show up for work)

And in fact it depends on the type of adverb. If the adverb does not create a truth-conditional
ambiguity with negation, negative neutralization still happens.
(19) Does John honestly not show up for work?
   a. Of course! (= John does not show up for work)
   b. Of course not! (= John does not show up for work)

We have only considered adverbs until now but even sentences containing no adverbs as in (20) produce such contrasts as long as a non-referential quantifying element is interpreted out of the scope of negation. Thus of course means that indeed someone did not try the food, whereas of course not conveys that everyone tried the food.

(20) Context: You had counted 12 guests, so you cut exactly 12 slices in the cake. One slice remains.
   A: Did someone not try the food at all?
   B1: Of course! Mary is fasting!
   B2: Of course not! Look! Everyone has chocolate on their face!

But if the quantifying element is interpreted in the scope of negation as in (21), the negative neutralization pattern reappears.

(21) A: Did no one try the food at all?
   B1: Of course! You made roast beef for a Vegan convention!
   B2: Of course not! You made roast beef for a Vegan convention!

Negative neutralization is lifted as long as negation is not the outer-most scope-bearing operator (Pasquereau, in press), thus compare (22) and (23).

(22) A: Did he not give cake to someone?
   B1: Of course! Mary is fasting!
   B2: Of course not! Look! Everyone has chocolate on their face!

(23) A: Did he not give cake to anyone?
   B1: Of course! He’s so stingy! He kept it all for himself!
   B2: Of course not! He’s so stingy! He kept it all for himself!

The generalization is summarized in (24).

(24) Generalization
   A negative BAR conveys agree when the highest scope-bearing operator in the question nucleus is negation, otherwise it conveys reverse.

The next section develops an analysis of this generalization.

4. Analytical proposal

The analysis I propose combines the system in Kramer and Rawlins (2010, 2011, 2012) (minus negative concord) with the system in Pasquereau (in press) to model the generalization in (24).
4.1. Background

The purpose of this section is to outline the assumptions I make about the structure of BARs. Having already exposed the trappings of Kramer and Rawlins’ ellipsis-based analysis, I focus in this section on extending and presenting the system in Pasquereau (in press).

4.1.1. Two Pol heads

Like previous work (Kramer and Rawlins, 2010, 2011, 2012; Kroll and Roberts, 2019), I assume that BARs involve an adverb adjoined to a Polarity head which bears Merchant (2001)’s E-feature and whose complement can optionally be elided under semantic identity with some constituent in the preceding question. I call this constituent ‘the ellipsis antecedent’. I use Merchant (2001)’s e-givenness notion of semantic identity (25).

(25) Definition of e-givenness (Merchant, 2016)
A expression \( \varepsilon \) is e-GIVEN iff \( \varepsilon \) has a salient ellipsis antecedent \( A \) such that \( [A] = \text{F-clo}(\varepsilon) \) and \( [\varepsilon] = \text{F-clos}(A) \)

(26) Definition of (existential) F-closure of \( \varepsilon \) (Schwarzschild, 1999)
\( \text{F-clo}(\varepsilon) = \text{the result of replacing F-marked phrases in } \varepsilon \text{ with variables and existentially closing the result, modulo existential type shifting.} \)

Notice that the definition licenses PF deletion of the prejacent under semantic identity with some ellipsis antecedent, not necessarily always the same constituent. Just like different constituents can introduce different discourse referents, an elided constituent can be interpreted with respect to different parts of a preceding utterance.\(^2\)

The constituent relevant for the interpretation of BARs is not necessarily exactly the same as the ellipsis antecedent. Therefore, I call the constituent (in the question) relevant for calculating the interpretation of the BAR ‘the PolP antecedent’ (PolP being one of the projections of the Pol head that the adverb in the BAR is adjoined to). In this paper, I consider that the PolP antecedent (i.e. the antecedent relevant for the interpretation of a BAR) is the nucleus of the preceding question, i.e. TP in (28). By contrast, the ellipsis antecedent is sometimes the whole TP, sometimes a smaller constituent, e.g. VP\(^3\).

\(^2\)In particular, given a negated sentence preceding an elided structure, either the full negative ellipsis antecedent can be retrieved as in (27a) or just its prejacent as in (27b). See Krifka (2013); Snider (2017).

(27) a. Soit vous n’avez pas empêché ce crime et vous expliquez pourquoi <vous n’avez pas empêché ce crime>, soit vous n’avez rien à vous reprocher et vous témoigner. ‘Either you didn’t prevent this crime and you explain why, or you don’t have anything to reproach yourself with and you can testify.’
b. Soit vous n’avez pas commis ce crime, soit vous nous explications pourquoi <vous avez commis ce crime>. ‘Either you didn’t commit this crime, or you tell us why.’

\(^3\)I do not commit to there being a vP in the structure. If one assumes the vP analysis of the introduction of external arguments Kratzer (1996), then TP or vP would be the possible ellipsis antecedents.
Following Roelofsen and Farkas (2014); Pasquereau (2018), I assume that the polarity head adverbs are adjoined to requires certain conditions to hold between the BAR and the discourse initiative it responds to. The Pol head is the seat of two types of information: it encodes the polarity of its TP complement and it encodes whether its TP complement agrees with the PolP antecedent or reverses it. In Roelofsen and Farkas (2014), this is two features—one absolute feature and one relative feature—base generated in Pol. Here, I depart from their account since I propose that what they formalize as ‘absolute features’ are in fact Pol heads. In the next section, I explain how Pol comes to reflect the polarity of its complement.

4.1.2. $\Sigma$ head and movement to Pol

Like Kramer and Rawlins (2011) and others (Sailor, 2012; Roelofsen and Farkas, 2014; Gribanova, 2017), I assume that every sentence has a polarity head $\Sigma$ with a feature valued positively or negatively. I assume that an interpretable positively-valued $\Sigma$ head is an identity function whereas an interpretable negatively-valued $\Sigma$ head takes a proposition and reverses its polarity.

\[ 29 \]
\[ \Sigma^+ = \lambda p. p \]
\[ \Sigma^- = \lambda p. \neg p \]

I assume that (i) Pol must agree with a $\Sigma$ head which then must undergo head movement to Pol (under the copy theory of movement, Chomsky (1992)) and that (ii) the higher copy of $\Sigma$ is interpreted (30). Note that only one copy of $\Sigma$ can be interpreted, thus the movement does not seem to leave a trace (reconstruction is not possible).

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4I call this polarity head Pol since my analysis builds on the idea in Roelofsen and Farkas (2014) that Pol heads host two types of features—relative and absolute—but nothing hinges on the particular name that head is given.

5The reader may object that $\Sigma$-to-Pol head movement does not respect the Head Movement Constraint since T stands above $\Sigma$ but below Pol. First, see Harizanov and Gribanova (2019) for arguments that certain types of head movement do not respect the HMC. Second, it could be the case that $\Sigma$ moves to $T$ at PF and then is ex-corporated and moves to Pol at LF.
Both claims are independently made and argued for in Gribanova (2017) in order to account for the different realizations of polarity focus in Russian. I assume that Pol has the denotation in (31) and combines with Σ via function application. The meaning of Pol is purely presuppositional. I talk about it further in section 4.4.

(31) $[\text{Pol}] = \lambda q_{<s,t>} \lambda p_{<s,t>}. \text{PRESUPPOSITION}(q(p)). q(p)$

Thus, what Roelofsen and Farkas (2014) call ‘absolute features’ are here not features but the copy of a lower Polarity head. I show in section 4.2 that extending these claims to BARs correctly predicts their interpretation. I now turn to explaining what the PRESUPPOSITION part of the denotation of Pol is.

4.1.3. Two types of Pol heads

Following Roelofsen and Farkas (2014) but in the vein of Gribanova (2017), I assume that there are two Pol heads in French: one marked with a feature [reverse], Pol$\text{reverse}$, and another marked with a feature [agree], Pol$\text{agree}$. The relative features encode a presupposition that at least one projection of PolP must satisfy (32).

(32) Presuppositions

a. Pol$\text{agree}$ presupposes that the context provides a salient constituent TP which denotes the PolP antecedent proposition $[\text{TP}]$ such that $[\text{PolP}]$ and $[\text{TP}]$ contain the same possible worlds

b. Pol$\text{reverse}$ presupposes that the context provides a salient TP which denotes the PolP antecedent proposition $[\text{TP}]$ such that $[\text{PolP}]$ is the complement of $[\text{TP}]$

Remember that there are two notions of antecedent: ‘the PolP antecedent’ for the meaning of PolP and ‘the ellipsis antecedent’ for the prejacent of PolP in case of ellipsis. Thus, the example in (30) has the syntax in (33a) and the interpretation in (33b).

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6A consequence of positing this denotation for Pol is that copy/movement of Σ to Pol and its interpretation in the high position is necessary for the structure to be interpretable.
(33) A: Did Marie not come?
B: Of course not.
a. LF: $[PolP_2$ of course $[PolP_1[Pol_{agree} Pol_{agree} Σ_{i-,}] TP Marie [ΣP Σ_{i-} has arrived ] ] ]$
b. $[PolP_1] = -(Marie has come)$, defined only if PolP denotes a proposition $α$ and the context provides a salient constituent TP which denotes the PolP antecedent proposition $β$ such that $α$ and $β$ contain precisely the same possible worlds

4.1.4. Realizational rules in French

Based on the generalization in (24), I assume the rules in (34) for English BARs.

(34) Realization potential for English BARs.

a. $Pol_{agree}$ and $Σ+$ are realized by so or silence
b. $Pol_{reverse}$ and $Σ-$ are realized by not
c. $[Pol_{reverse}, Σ+]$ is realized by silence followed by a non-elided clause

As a consequence of (34), the four possible feature combinations are realized as in (35). The last combination of features (35d) is, to put it briefly, not realized as my account on its own (so far) predicts. Note that previous accounts too have grappled with the peculiarities of this particular configuration. I discuss it further in section 5.

(35) Head combinations and BARs in English

a. $[Pol_{agree}, Σ+]$ may be realized by so or silence
b. $[Pol_{reverse}, Σ-]$ can only be realized by not
c. $[Pol_{agree}, Σ-]$ can be realized by so or silence or not (negative neutralization)
d. $[Pol_{reverse}, Σ+]$ can be realized by silence followed by a non-elided clause (see 5)

4.1.5. Covert $Σ$ insertion as a last resort

Ovalle and Guerzoni (2004); Zeijlstra (2008); Fălăuș and Nicolae (2016) assume that a Covert Negation can be inserted in a high projection only when part of the structure has been elided (36).

(36) Condition on covert negation (Fălăuș and Nicolae, 2016)

A covert negative operator can only surface if the vP is not spelled out.

This assumption correctly captures an asymmetry in the interpretation of N-word in full sentences vs in fragments in Romanian. The full sentence in (37) can have the negative concord reading whereas the double negative reading is not possible.
(37) *Nimeni nu a venit.*
   nobody not has come
   Negative Concord: Nobody came.
   *Double Negation: Everybody came.

Interestingly, if the same N-word is used as a fragment answer to a negative wh-question as in (38), the double negation reading becomes available.

(38) A: *Cine nu a venit?*
   who not has come
   Who didn’t come?
   B: *Nimeni.*
   nobody
   Negative Concord: Nobody came.
   Double Negation: Everybody came.

Assuming that N-word fragment answers are derived via ellipsis from an underlying structure like (37), Fălăuş and Nicolae (2016) analyze the double negation reading in (38) as arising from the insertion of negation high in the structure. Crucially, the double negation reading is not available in (37) because covert negation can only be inserted when vP is elided.

I follow Fălăuş and Nicolae (2016) in assuming that Covert Σ- insertion is limited to elliptical constructions. In fact, I further extend this assumption to Σ+. It is not the case that covert Σ insertion is freely available. If it were, we would expect unaccented BARs to be able to convey reverse in examples like (39). But it crucially does not: BARs can only convey agree in (39) because covert Σ insertion is not needed to salvage the construction.

(39) A: Has Jean not arrived? B: Of course not.

   a: LF1: \([\text{Pol}_P \text{of course } \text{Pol}_P \text{Pol}_{agree} \text{Pol}_{agree} \Sigma_{\text{i}}^{-}] [TP \text{Jean } \Sigma_{\text{i}}^{-} \text{has arrived }] \]
   Correctly predicted reading: Of course, Jean has not arrived.

   b: *LF2: \([\text{Pol}_P \text{of course } \text{Pol}_P \text{Pol}_{rev} \Sigma_{\text{i}}^{-}] [\Sigma_{\text{i}}^{-} [TP \text{Jean } \Sigma_{\text{i}}^{-} \text{has arrived }] \]
   Incorrectly predicted reading: Of course, Jean has arrived.

I contend that insertion of covert Σ is a last resort rescuing mechanism limited to elliptical constructions (40).

(40) **Condition on covert Σ**
   A covert Σ can only be inserted if:
   - the vP is not spelled out
   - not inserting it would result in an uninterpretable structure

4.2. Analysis

The moving pieces of the analysis are summarized in (41).

(41) a. Is covert Σ inserted?
   Covert Σ can only be inserted as a last resort to rescue an elided structure which would otherwise be uninterpretable.

   b. What Σ head moves to Pol?
   Either covert Σ or Σ from the prejacent moves to Pol.
c. Which Pol head is used?
   Either Pol\textit{agree} or Pol\textit{reverse} can be used provided its presupposition is licensed.

d. Is ellipsis licensed?
   Ellipsis of the prejacent is licensed only if it is e-given with respect to some constituent in the preceding discourse initiative.

I start with the simple cases seen in section 2. In response to the positive question in (42), Pol \textit{AGREES} with \textit{\Sigma+} which head-moves to Pol. The presupposition of Pol\textit{agree} is met since \textit{[PolP\_1]} is equivalent to its PolP antecedent, i.e. the TP in the question. The Pol head is spelled out as \textit{silence} as per the morphophonological rules in section 4.1.4. The TP in the response can be elided since it is e-given with respect to its ellipsis antecedent, i.e. VP or the TP in the question.

(42) \textbf{Positive Q, of course answer}
A: Is Alfonso going to the party? B: Of course (= of course he is going to the party).

a. LF of A: \([CP \ Q \ [TP \ [\Sigma+ \ [VP \ Alfonso is going to the party ] ] ] ]\)
   \([\text{PolP antecedent}] = [[TP \ [\Sigma+ \ [VP \ A. is going . . . ] ] ] ] = \text{Alfonso . . . to the party}\)
   \([\text{Ellipsis antecedent}] = [[VP \ Alfonso is . . . the party ] ] = \text{Alfonso is going to the party}\)

b. LF of B: \([\text{polP\_2 of course} \ [\text{polP\_1} \ [\text{polP\_agree} \ \Sigma\_i+ ] \ [\text{TP he } \Sigma\_i+ \text{ is going to the party } ] ] ]\)
   \([\text{PolP\_1}] = [[\text{polP\_1} \ [\text{polP\_agree} \ \Sigma\_i+ ] \ [\text{TP he } \Sigma\_i+ \text{ is . . . } ] ] ] = \text{A. . . . to the party}\)
   \([\text{TP}] = [[TP \ he \ is \ going \ to \ the \ party ] ] = \text{Alfonso is going to the party}\)

In response to a simple negative question (i.e. with no other scope-bearing operator), Pol \textit{AGREES} with \textit{\Sigma-} which head-moves to Pol. The presupposition of Pol\textit{agree} is met since \textit{[PolP\_1]} is equivalent to its PolP antecedent, i.e. the TP in the question. The Pol head is spelled out as \textit{silence} or \textit{not} as per the morphophonological rules in section 4.1.4. The TP in the response can be elided since it is e-given with respect to its ellipsis antecedent, i.e. the VP in the question (remember that only the highest \textit{\Sigma} is interpreted).

(43) \textbf{Negative Q, of course (not) answer (agreement) - NEGATIVE NEUTRALIZATION}
A: Is Alfonso not going to the party? B: Of course (not) (= of course he is not going . . . ).

a. LF of A: \([CP \ Q \ [TP \ [\Sigma- \ [VP \ Alfonso is going to the party ] ] ] ]\)
   \([\text{PolP antecedent}] = [[TP \ [\Sigma- \ [VP \ Alfonso is . . . ] ] ] ] = \neg (A. is going to the party)\)
   \([\text{Ellipsis antecedent}] = [[VP \ Alfonso is . . . the party ] ] = \text{Alfonso is going to the party}\)

b. LF of B:
A negative BAR to a positive question may only express reverse: Pol AGREES with Σ- which head-moves to Pol. The presupposition of Pol_rev is met since \([\text{PolP}_1]\) is equivalent to the negation of its PolP antecedent, i.e. the TP in the question. The Pol head is spelled out as not as per the morphophonological rules in section 4.1.4. The TP in the response can be elided since it is e-given with respect to its ellipsis antecedent, i.e. the VP or TP in the question.

(44) Positive Q, of course not answer

A: Is Alfonso going to the party? B: Of course not (= of course he is not going ...).

a. LF of A: \([CP Q [TP Σ+ V P Alfonso is going to the party ]] \] \(\text{PolP antecedent} = [ [TP Σ+ V P Alfonso ... ]] = \text{Alfonso is going to the party} \)
\(\text{Ellipsis antecedent} = [ [V P Alfonso is ... the party ]] = \text{Alfonso is going to the party} \)

b. LF of B: \([PolP_2 \text{ of course } [PolP_1 Pol_{agree} Pol_{rev} Σ_i Σ_r ] [TP he Σ_r is going to the party ]]] \) \(\text{[PolP}_1] = [ [polP_1 Pol_{agree} Σ_i Σ_r ] [TP he Σ_r is going ... ]] = ¬(A. is ... party) \)
\(\text{[TP]} = [[TP he is going to the party ]] = \text{Alfonso is going to the party} \)

If negation is present but it is not the outermost scope-bearing operator—in (45a) negation is in the scope of unspecific someone, a PPI—the underlying structure of the negative BAR must be as in (45b) which involves Covert Negation insertion. To see this, let’s consider the alternative underlying LF in (45a) which does not involve Covert Negation insertion. In this structure, once Σ has moved to Pol, whether Pol_{agree} or Pol_{reverse}, neither presupposition is met since \([\text{PolP}]\) is not equivalent to (the negation of) any constituent in the antecedent. In addition ellipsis is not licensed either. To salvage this structure, Covert Negation (or Covert Σ- to be more specific) is inserted (45b) and moves to Pol under AGREE. The presupposition of Pol_{rev} is met since \([\text{PolP}]\) is equivalent to the negation of TP in the antecedent. TP ellipsis is licensed as it is e-given with respect to its ellipsis antecedent, i.e. TP in the question. The resulting meaning is correctly predicted to reverse the question nucleus.

(45) Negative Q, of course (not) answer

A: Is someone not going to the party? B: Of course not = everybody is going.

LF of A: \([CP Q [TP someone; Σ- V P t_i is going to the party ]] \) \(\text{[PolP antecedent} = [ [TP someone; Σ- V P t_i is going to the party ]] = \exists x. ¬(x is going to the party) \)
Therefore, assuming that Pol heads are specified for agree or reverse correctly predicts the pattern of data we see with polar adverbial responses in English. In the following sections, I address a couple of issues related to the account proposed here.

5. Ramifications and outstanding issues

5.1. Responses to high negation questions

Responses to negative questions like (46A) are reported to pattern like responses to positive questions (Kroll and Roberts, 2019).
A: Doesn’t John bathe on Saturdays?
B1: Of course. (= John bathes on Saturdays)
B2: Of course not. (= John doesn’t bathe on Saturdays)

This pattern follows from the account presented here if we assume that in these questions negation is interpreted above TP as in the account of high-negation polar questions in Romero and Han (2004) according to which negation preposing in polar questions contributes an epistemic operator \textit{VERUM}. According to this account, the LF of (46A) can be as in (47) where \textit{VERUM} has triggered the preposing of negation (i.e. $\Sigma^-$).

\begin{equation}
\text{LF of A: } [CP \ Q \ [\Sigma^-] \ [\text{VERUM} \ [TP \ John \ \Sigma^- \ \text{bathe on Saturdays}]]]
\end{equation}

\text{LF of B1: } [\text{PolP}_2 \ \text{of course} \ \text{[PolP}_1 \ \text{PolP}_1 \ \text{PolP}_1 \ \Sigma^+ \ [TP \ \text{he} \ \Sigma^+_+ \ \text{is going to the party}]]]

\text{LF of B2: } [\text{PolP}_2 \ \text{of course} \ \text{[PolP}_1 \ \text{PolP}_1 \ \text{PolP}_1 \ \Sigma^- \ [TP \ \text{he} \ \Sigma^-_+ \ \text{is going to the party}]]]

The BAR in B1 is derived as follows: Pol \textit{AGREES} with $\Sigma^+$ which head-moves to Pol. The presupposition of Pol$_{agree}$ is met since $[\text{PolP}_1]$ is equivalent to its PolP antecedent, i.e. the TP in the question since $\Sigma^-$ has been preposed and is interpreted above \textit{VERUM}. The Pol head is spelled out as \textit{silence} as per the morphophonological rules in section 4.1.4. The TP in the response can be elided since it is e-given with respect to its ellipsis antecedent, i.e. the VP or the TP in the question. In B2, Pol \textit{AGREES} with $\Sigma^-$ which head-moves to Pol. The presupposition of Pol$_{rev}$ is met since $[\text{PolP}_1]$ is equivalent to the negation of its PolP antecedent, i.e. the TP in the question. The Pol head is spelled out as \textit{not} as per the morphophonological rules in section 4.1.4. The TP in the response can be elided since it is e-given with respect to its ellipsis antecedent, i.e. the VP or the TP in the question.

5.2. On the realization of [Pol$_{reverse}$, $\Sigma^+$]

An outstanding issue for my account, and ellipsis-based accounts in general, is that BARs in response to (48A) cannot convey reverse, they can only convey \textit{agree} under the account I have proposed. The only way to reverse is to have a sentence follow the adverb (49a). Why this is the case has to my knowledge not been explained so far though this is an area of active research.

(46) A: Doesn’t John bathe on Saturdays?
B1: Of course. (= John bathes on Saturdays)
B2: Of course not. (= John doesn’t bathe on Saturdays)

(48) A: Did John not try the food?  (49) A: Did John not try the food?

a. B1: Of course!
   =$\text{John did not try the food}$
   *=John tried the food

b. B1: Of course not!
   =$\text{John did not try the food}$
   *=John tried the food

b. *B1: Of course not, he did!
   =$\text{John tried the food}$

c. Of course not! He did.
   *=John tried the food

The issue is that a BAR response—negative or positive—to a simple negative question like (49A) is predicted in my account to be structurally ambiguous between a [Pol$_{agree}$, $\Sigma^-$] \textit{(agree)} configuration (50a) and a [Pol$_{reverse}$, $\Sigma^+$] \textit{reverse} configuration (50b).
(50) **Negative Q, of course (not) answer**

A: Did John not try the food? B: Of course (not)!

a. LF of agree reading:

\[
[\text{PolP}_2 \text{ of course } [\text{PolP}_1 \text{ Pol}_{agr} \Sigma_i^- \text{ he did } \Sigma_i^- \text{ try the food }]]
\]

b. LF of reverse reading:

\[
[\text{PolP}_2 \text{ of course } [\text{PolP}_1 \text{ Pol}_{rev} \Sigma_i^+ \text{ he did } \Sigma_i^+ \text{ try the food }]]
\]

The agree reading is derived from a structure (50a) in which the Pol head is specified for agree and \(\Sigma_i\), which can be realized by *of course* or *of course not* as per the rules in section 4.1.4: this is negative neutralization. In response to (50A), the issue is that the same string *of course (not)* is predicted to correspond to an equally-well formed structure in (50b), which according to the realization rules in section 4.1.4, predicts that both *of course (not)* should be possible to convey reverse in response to (50A), contrary to observations. I do not currently have an explanation as to why this configuration prevents ellipsis and leave it for further research. One potential avenue is that such configurations require verum focus (as pointed out in Kramer and Rawlins’s work and Roelofsen and Farkas, 2014) which could block ellipsis.

6. Conclusion

I have proposed a new empirical generalization concerning the interpretation of BARs in English and built on previous ellipsis-based accounts to model this generalization by adapting an analysis proposed in Pasquereau (in press) for French embedded Polar Response Particles. This new analysis keeps the merits of previous analyses of BARs while extending their empirical coverage. A crucial part in this new account is played by \(\Sigma\) movement. Although negation has standardly been assumed not to be subject to movement rules, recent work on Neg-raising has argued that clausal negation can move in certain cases (Collins and Postal, 2017). Intriguingly, Crowley (2019)’s work on Neg-raising derives a generalization similar to the effect my analysis tries to capture, namely that ‘Neg-movement only applies if it is semantically vacuous’. In addition to solving the problematic issue raised in section 5, it is to be hoped that further research will establish the relationship between the generalization proposed here for BARs (and in Pasquereau (in press) for PRPs) and Crowley’s generalization for Neg-movement.

References


Pasquereau, J. (2017, April). On the interpretation of non as a function of the highest scope-bearing operator in its antecedent. Presentation given at the semantics workshop at the University of Massachusetts Amherst.
Empirical investigations on quantifier scope ambiguities in German
Mareike PHILIPP — Universität Potsdam
Malte ZIMMERMANN — Universität Potsdam

Abstract. The paper presents the results of a novel experimental study on inverse scope readings in German, which are considered to be possible only under highly constrained conditions in prior literature (Frey 1993; Pafel, 2005; Bobaljik & Wurmbrand, 2012). We show that inverse scope readings are in fact possible in canonical main clauses with an ∃-subject QP preceding and c-commanding an ∀-object QP under verum focus, with the potential of object-scrambling over the subject. The existing literature on quantifier scope in German is unanimous in claiming that inverse scope is impossible in this configuration. Our findings are line with previous experiments on German that found inverse readings to be available in other syntactic configurations (e.g. Bott & Radó, 2007; Radó & Bott 2011; Bott & Schlotterbeck, 2015). Moreover, the availability of inverse readings is boosted when the context biases towards them, a finding which is compatible with previous evidence suggesting that context plays an important role in scope ambiguity resolution (Kurtzman & MacDonald, 1993; Saba & Corriveau, 2001; Villalta, 2003; Reinhart, 2006). Our results also suggest that inverse readings are not banned from relative clauses, a result that is incompatible with the assumptions that relative clauses are islands, and that inverse scope interpretations are obtained via the covert movement operation QR in syntax. Finally, we show that scope interpretation strategies differ drastically between speakers of the same language, in line with introspective judgments.

Keywords: quantifiers, scope, ambiguity, experiment, German, Quantifier Raising, relative clauses, islands, world knowledge.

1. Introduction

English sentences containing more than one quantificational expression give rise to quantifier scope ambiguities. An example with two argument QPs is given in (1).

(1) A drone surveilled every building.

This sentence contains an existential subject-QP a drone and a universal object-QP every building. Under the surface reading (SR), on which the ∃-subject QP takes scope over the structurally lower ∀-object QP, the ∃-QP takes wide scope, giving rise to the interpretation that there is exactly one drone that surveilled all the buildings. Under the inverse reading (IR), it is the ∀-object QP taking scope over the ∃-subject QP, giving rise to the interpretation that for every building there is a drone such that this drone surveils it.

May (1977) proposes a syntactic derivation of inverse scope readings by means of quantifier raising (QR) at the representational level of Logical Form (LF), effectively reducing scope ambiguities to structural ambiguities. Quantifiers covertly rise out of vP at LF for reasons of interpretability. With sentences containing two QPs, the resulting c-command relationship between the two QPs at LF determines which reading is obtained. Thus, the two readings of (1) can be represented in a simplified manner as in (2).
Importantly, QR is typically taken to obey the same constraints that also apply to overt A’-movement (Huang 1995). This theory has been adopted and modified by many subsequent authors (e.g. May, 1985; Heim & Kratzer, 1998; Chierchia & McConnell-Ginet, 2000; Fox, 2000 i.a.).

Even though sentences like (1) are potentially ambiguous, the readings are often not available to the same extent, and sometimes one reading is in fact completely ruled out. In general, inverse readings have been observed to be less available than surface readings across languages. They are grammatically dispreferred (e.g. Reinhart, 2006) and induce higher processing costs (e.g. Kurtzman & MacDonald, 1993; Anderson, 2004). Over the years, both theoretical as well as experimental work has accumulated a large number of possible factors with an impact on the availability of inverse readings, depending on the grammar of a given language: prosody (Frey, 1993; Büring, 1997; Krifka, 1998; Pafel, 2005), linear order (Reinhart, 1983; Frey, 1993; Pafel, 2005), word order flexibility (Krifka, 1998; Bobaljik & Wurmbrand, 2012), syntactic construction (Sauerland & Bott, 2002), syntactic constraints (Bobaljik & Wurmbrand, 2012), grammatical role (Ioup, 1975; VanLehn, 1978; Pafel, 2005), semantic role (Frey, 1993; Pafel, 2005), features of the determiners (Ioup, 1975; VanLehn, 1978; Ruys, 1983; Beghelli & Stowell, 1997; Szabolcsi, 1997; Pafel, 2005), information structure (Partee, 1991; Frey, 1993; Suranyi & Turi, 2017), discourse anaphoricity (Pafel, 2005), context/world knowledge (Kurtzman & MacDonald, 1993; Saba & Corriveau, 2001; Villalta, 2003; Anderson 2004), as well as economy principles (Fox, 1995).

Specifically for German, several authors have claimed that inverse readings are hardly ever available, and to the extent that they are, they can only occur in a very restricted set of contexts. Frey (1993), for instance, proposed the Scope Principle, which says that a QP A has scope over a QP B, iff the head of the chain A c-commands the base of the chain B. In other words, a given QP₁ can only take scope over another QP₂, if QP₁ c-commands QP₂ directly in overt syntax, or else if QP₁ c-commands the base position of QP₂ after overt movement. It follows that inverse readings in German are only possible with non-canonical word orders after overt movement. Inverse readings are thus not obtained via QR but via reconstruction at LF. An example is given in (3) vs. (4):

(3) Tatsächlich HAT mindestens eine Drohne fast jeden Hügel überflown.
Indeed, at least one drone has overflown almost every hill.

According to Frey (1993), the sentence in (3) should be unambiguous and only have the surface existential reading. Example (4) with overt object scrambling, by contrast, can have both readings since the existential subject QP c-commands the base position of the existential object QP. This analysis is subject to two constraints limiting its range of applicability. First, Frey acknowledges that prosody can have an impact on interpretation and that therefore, the predictions only hold for sentences with verum focus. Second, Frey does not consider many quantificational expressions as bona fide quantifiers, thereby restricting the scope principle to
only hold for a subset of quantificational expressions. This excludes default quantificational expressions such as indefinite *ein* ‘a/some’ or *jeder* ‘every’, but includes complex expressions such as *mindestens ein* ‘at least one’ or *fast jeder* ‘almost every’. According to Frey, the unmodified existential indefinite *ein* ‘one’ can also receive a directly referential interpretation, on which it would be scope free, and universals such as *jeder* ‘every’ can also receive a referential interpretation under a collective construal. Crucially, though, the same argument can be made for expressions that, according to Frey, are actual quantifiers. For instance, *mindestens ein* ‘at least one’ can also receive a referential interpretation via reconstruction of its witness set (Szabolcsi 1997), and the same would appear to hold for *fast jeder* ‘almost every’, which likewise allows for anaphoric reference with the 3rd plural pronoun *sie* ‘they’. For this reason, and because they impose fewer processing constraints on experimental participants, we decided to carry out the experiment on the simple quantificational expressions *ein* and *jeder*; see also Footnote 1.

The multi-factorial account of Pafel (2005) also considers non-syntactic factors to have an impact on quantifier scope interpretation in German. Following Ioup (1975), Pafel argues that many different weighted factors interact with each other in a cumulative manner, thereby resulting in different scope preferences. In particular, each relevant factor has a fixed value, which is assigned to the QP in the sentence that this factor applies to. The single values are then multiplied by five, and the results summed up. For sentences with two QPs, the resulting numerical values for the individual QPs are compared. If the difference is greater than or equal to five, the sentence will be unambiguous, assigning wide scope to the QP with the higher value. If the difference is smaller than five, the sentence will ambiguous. For example,

\[ Einen\ Hügel\ überflog\ jede\ Drohne. \]

*A hill* \textsubscript{obj} \textit{overflew} every *drone* \textsubscript{sbj}.

\[ \cdot \text{linear order}: 1.5 \times 5 = 7.5 \]
\[ \cdot \text{grammatical function}: 1 \times 5 + \text{distributivity}: 1 \times 5 = 10 \]

(5) is ambiguous because the difference of the resulting values (7.5 vs. 10) is smaller than five. The Θ-QP receives a value for the factor linear order, because it linearly precedes the ∀-QP. The ∀-QP in turn receives a value for grammatical function, because it is the subject, and subjects are more prone to take wide scope. The ∀-QP also receives a value for distributivity, because it has the inherent feature of being distributive, which also increases the likelihood for wide scope (Ioup 1975). The advantage of Pafel’s approach is that it can account for the influence of many different factors. However, it is more descriptive than explanatory in nature, and the values were only assigned on the basis of introspective judgments.

Finally, Bobaljik & Wurmbrand (2012) provide a principled account of quantifier scope preferences across various languages. They reject the notion of global scope rigidity for individual languages, such as German, and assume that the operation of QR is universally available across languages. In addition, they suggest that a soft economy constraint called Scope Transparency (ScoT) is at play. This constraint says that if A precedes B at LF, then A also precedes B at PF. This constraint is violable, for instance if it is outperformed by a higher-ranked constraint blocking overt movement. This way, Bobaljik & Wurmbrand (2012) arrive at a notion of local scope rigidity. They predict that ScoT strongly restricts the
availability of inverse readings in German with its relatively free word order. This is so because, in principle, in many cases overt movement of the structurally lower QP would be possible so that there is no reason for violating ScoT by having a mismatch between LF and PF. In a rigid word order language such as English, however, ScoT is frequently violated as overt movement is blocked, thereby allowing for inverse scope readings. However, inverse readings are possible even in German, namely in configurations in which overt movement is blocked by general and inviolable constraints on movement. This is shown in (6).

(6)  
Context: Two friends are talking about last night, when one of them visited Peter, who is crazy about jazz. On that occasion, Peter played a record by Miles Davis, a record by John Coltrane, and a record by Fred Frith.

a. Peter hat eine Platte jedes Musikers aufgelegt.  
   Peter has a record every musician played

a'. *Peter hat jedes Musikers eine Platte aufgelegt]  
   Peter has every musician a record played

b. Peter hat eine Platte von jedem Musiker aufgelegt.  
   Peter has a record by every musician played

b'. Peter hat von jedem Musiker eine Platte aufgelegt.  
   Peter has by every musician a record played

'Peter has played a record by every musician.'
(adapted from Bobaljik & Wurmbrand 2012: 381f.; exs.12a & 13a)

In nested DPs such as in (6a), the lower ∀-QP each musician_{GEN} is the genitive complement of the higher existential a record, and cannot move overtly, as evidenced by the ungrammaticality of (6a'). (6a) is therefore predicted to be ambiguous. In (6b), however, the second QP by every musician is a PP-adjunct and can overtly move, as seen by the grammaticality of (6b'). (6b) is therefore predicted to only allow for the surface reading.

A number of experimental studies on quantifier scope ambiguities in German are found in the literature, some explicitly testing for the adequacy of the theoretical accounts above (Bott & Radó, 2007; Bott & Radó, 2009; Radó & Bott, 2011; Radó & Bott, 2018; Bott & Schlotterbeck, 2012; Bott & Schlotterbeck, 2015). These studies show (i.) that ∀-QPs headed by the distributive universal jeder (= ‘every’) take wide scope more often than those featuring the collective universal alle (= ‘all’), (ii.) that linear order plays an important role in that the surface reading is typically the preferred reading, and (iii.) that d-linked QPs (e.g. partitives) take wide scope more often than non-d-linked QPs. The experimental studies also provided some evidence that inverse readings are accepted in many different contexts even though they are generally dispreferred. In fact, the inverse reading even seems to be the preferred interpretation in inverse linking constructions, such as [Ein Apfel in jedem Korb] ist faul ‘An apple in every basket is rotten’ (Bott & Radó, 2009; 2011). The authors conclude that the experimental results are not fully compatible with any of the theories on quantifier scope in German, but mostly in favour of multi-factorial accounts à la Pafel (2005). Our experiment adds to the available empirical evidence on quantifier scope in German by focussing on a syntactic configuration that has not been investigated in previous experimental work, except for an informal pen-and-paper study in Zimmermann (1997): sentences with ∃-subject QP and ∀-object QP in canonical word order (= no overt movement) under verum focus to control for the effects of accent. We present evidence that inverse scope readings are
available in this syntactic configuration, for which none of the above theories on German quantifier scope has deemed possible. In addition, we also look at the role of syntactic constraints on islandhood, as well as at the impact of context/world knowledge on the interpretation of potentially scope ambiguous sentences.

2. Experiment: An offline study on the availability of inverse scope in German

In this experiment we investigated the general availability of inverse scope readings between ∃-subject and ∀-object QPs (in this order) by means of an offline behavioural task. We judged for the (un)availability of a given scope reading by presenting participants with critical target sentences in contexts and by eliciting yes/no-responses on a content question that would allow to assess the availability (yes-answer) or unavailability (no-answer) of this scope reading. In particular, we were interested in the following three research questions:

Q1: Is inverse scope between ∃-subject QPs and ∀-object QPs available in German? The three analyses of quantifier scope ambiguities in German above differ regarding the configurations for which they predict inverse scope readings to be available. However, they all agree that inverse readings are unavailable in the critical syntactic configuration in (7a), illustrated again in (7b), at least under verum focus.

(7) a. … V FIN ∃-SUBJ ∀-OBJ V
b. … und tatsächlich hat dann [‘ne Drohne] [jedes Gebäude] überwacht.
   and indeed has then a drone every building surveilled
   … and then, indeed, a drone surveilled every building.

Q2: Does context plausibility have an impact on the availability of inverse scope? While there is some work on English quantifier scope suggesting that context or world knowledge may play a crucial role in resolving scope ambiguities (Reinhart 2006), this has not been subject to systematic experimental research in German or other languages, which tends to focus on structural, semantic, and prosodic factors.

Q3: Does embedding into a syntactic island render the inverse reading impossible? Inverse readings are often derived syntactically by the covert movement operation of Quantifier Raising. Whereas neither Pafel’s (2005) nor Frey’s (1993) theory is based on QR, Bobaljik & Wurmbrand’s (2012) is. Since QR is claimed to be blocked by inviolable syntactic constraints on overt movement, we would expect inverse scope out of relative clause islands to be systematically unavailable. We therefore also test for inverse scope out of relative clause islands.

2.1. Experimental Design

Target Sentences: We employed a 2x3 Latin Square design with the factors (i) context plausibility (2 levels) and (ii) island embedding (3 levels). The former was a between-item manipulation with the levels neutral, in which both surface and inverse reading were equally plausible, and IR-biased, in which only the inverse reading was compatible with common
knowledge. An example for a scenario with an IR-bias is shown in (9), in which it is extremely unlikely that a single tree would block every entrance to the city. A pre-test in which participants had to rate the plausibility of the two scenarios allowed us to assign half of the items to neutral and half of the items to IR-biased. This factor was included to test for Q2 regarding the influence of world knowledge and plausibility considerations on scope interpretation. The second factor, island embedding, was a between-item manipulation with the levels 0-emb, in which the target sentence remained unembedded; 1-emb, in which the V-object QP was embedded in a relative clause island; and 2-emb, in which the V-object QP occurred doubly embedded. We included this factor to test for Q3 regarding the availability of inverse scope from syntactic islands. An example for the neutral condition is given in (8) and for the IR-biased condition in (9). The different target sentences where followed by either of two content questions Q-SR or Q-IR, shown in both (8’) and (9’), which tested for the availability of surface and inverse scope reading, respectively.

(8) neutral
Der Agrarexperte hatte empfohlen, dass die Felder durch breite Kanäle bewässert werden sollten, …
The agriculture expert had recommended that the fields be irrigated by wide canals,

0-emb … und tatsächlich hat dann 'n breiter Kanal jedes Feld bewässert.
... and then, indeed, a wide canal irrigated every field.

1-emb … und tatsächlich hat sich dort dann 'n breiter Kanal befunden, der jedes Feld bewässert hat.
... and then, indeed there was a wide canal that irrigated every field.

2-emb … und tatsächlich war dort dann 'n breiter Kanal, der so angelegt war, dass er jedes Feld bewässert hat.
... and then, indeed, there was a wide canal, which was constructed in such a way that it irrigated every field.

(8’) Kann man diesen Satz so verstehen, dass es hier insgesamt…
Can this sentence be understood to mean that overall …
Q-SR … nur einen einzigen Kanal gab, der die Felder bewässert hat? Yes/No
... there was only a single canal that irrigated the fields?
Q-IR … mehr als einen Kanal gab, der die Felder bewässert hat? Yes/No
... there was more than one canal that irrigated the fields?

(9) IR-biased
Die Polizei hatte vor dem Sturm davor gewarnt, dass die Zufahrten in die Innenstadt durch umgestürzte Bäume blockiert werden könnten, …
The police warned before the storm that the entrances to the city centre could be blocked by fallen trees …

0-emb … und tatsächlich hat dann 'n umgestürzter Baum jede Zufahrt blockiert.
... and then, indeed, a fallen tree blocked every entrance.

1-emb … und tatsächlich hat dort dann 'n umgestürzter Baum gelegen, der jede Zufahrt blockiert hat.
... and then, indeed, there was a fallen tree that blocked every entrance.
2-emb … und tatsächlich war dort dann 'n umgestürzter Baum, der so gelegen hat, dass er jede Zufahrt blockiert hat.

... and then, indeed, there was a fallen tree that was positioned in such a way that it blocked every entrance.

(9') Kann man diesen Satz so verstehen, dass es hier insgesamt …

Can this sentence be understood to mean that overall …

Q-SR … nur einen einzigen umgestürzten Baum gab, der die Zufahrten blockiert hat?

... there was only a single tree that blocked the entrances? Yes/No

Q-IR … mehr als einen umgestürzten Baum gab, der die Zufahrten blockiert hat?

... there was more than one tree that blocked the entrances? Yes/No

As can be seen in (8) and (9), all target items came with canonical word order, that is with the subject QP preceding and c-commanding the object QP at surface structure. The subject was always an existential QP with the abbreviated form 'n(e) of the indefinite article ein(e) (= ‘a/some’), whereas the object was always a universal QP headed by the distributive universal jede(r) (= ‘every’). Using the abbreviated form instead of the full form of the indefinite was a way of controlling for intonation in a written experiment. The abbreviated form cannot carry stress, thereby avoiding potential prosodic confounds, which could boost either (i.) a specific (= wide scope, Krifka 1998, Ebert 2009) interpretation of the indefinite, namely if participants give it main stress, or (ii.) an inverse scope interpretation, namely if participants read the sentence with a rise-fall contour (Krifka, 1998). Moreover, as Frey’s (1993) strict claim against inverse scope was restricted to verum-focus contexts, we included this factor into our design as well.1 In order to justify the use of the somewhat colloquial form ‘n(e), we adapted all word forms in the experimental items to exhibit a more colloquial style. The preceding contexts always contained two DPs corresponding to the NP-complements of the existential and universal quantifier in the target sentence QPs. This was done in order to control for information structure by giving both QPs the information status given, resulting in de-accenting (Schwarzschild 1999). Moreover, the context sentences were in the passive voice, so that linear order and grammatical role of the relevant DPs was reversed. This was done to control for the topic-comment structure of the target sentences: For instance, the initial definite subject DP die Felder ‘the fields’ in the context clause in (8) plausibly constitutes the topic of the target sentence as well. This manipulation was introduced because Bobaljik & Wurmbrand (2012) allow for the possibility of inverse scope, i.e. a violation of ScoT, if overt movement is blocked by the information-structural constraint Topic > Focus. Given that the most plausible candidate for topic status in our target sentences is the ∀-object QP, we are confident that overt movement is not blocked by information structure. The DPs

1 As discussed above, the claims in Frey (1993) are also restricted to what is considered bona fide quantifiers that do not allow for a referential type <e>-interpretation. However, using such quantifiers would require exposing participants to process more complex constructions like Mindestens ein Baum hat fast jede Straße blockiert. (= ‘At least one tree blocked almost every road’), which in turn might induce another confound due to processing overload. Because of this, and since we are not convinced that modified quantifiers disallow referential interpretations, we omitted this aspect from our design. In addition, the use of the reduced weak indefinite form ‘ne significantly diminishes the possibility of a referential specific construal for the existential QP.
occurred in their number-neutral plural form in the contexts (Corbett 2000, Chierchia 1998).

Each target sentence was followed by one out of two possible questions, Q-SR and Q-IR, respectively. Half of the items were followed by Q-SR and half of the items by Q-IR, in randomized order. Again, this kind of task allowed us to investigate to what extent inverse scope readings are available at all, in contrast to some kind of forced-choice task, that can only test which reading is preferred. Our linking hypothesis is that the inverse scope reading is available for a participant for a given item if the participant answers Q-IR in (8’) or (9’) with ‘Yes’, and that it is unavailable if Q-IR is answered with ‘No’.

**Filler/Control Items**: In addition to the critical items, we also included five different types of filler/control items, which were all unambiguous in only allowing for either a yes- or a no-response to Q-SR and Q-IR. The three conditions in (10)–(12) should elicit ‘yes’-responses to Q-SR, and the two conditions in (13)–(14) should elicit a ‘yes’-response to Q-IR.

(10) **No universal QP**: Q-SR ⇒ yes, Q-IR ⇒ no

Die Angestellten der Pistenwache ham wegen der Lawinengefahr angekündigt, ’ne Piste vorübergehend zu sperren, und tatsächlich ham sie dann auch ’ne Piste gesperrt.3

*The employees of the ski patrol announced that they would temporarily close a ski slope due to the danger of avalanches, and then, in fact, they did close a ski slope.*

(11) **No universal, 2-emb**: Q-SR ⇒ yes, Q-IR ⇒ no

Die Sekretärin hat vorgeschlagen, dass der verschwundene Brief unter Mappen versteckt sein könnte, und tatsächlich war dort dann ’ne Mappe, die so gelegen hat, dass sie den Brief bedeckt hat.

*The secretary suggested that the missing letter might be hidden under folders, and then, in fact, there was a folder that was positioned in such a way that it covered the letter.*

(12) **Referential**: Q-SR ⇒ yes, Q-IR ⇒ no

Die Reisenden ham verlangt, dass ’ne Fahrt an die Ostsee angeboten wird, und tatsächlich hat dann ’ne Busfahrerin jeden Reisenden zur Ostsee gefahren. Ich hab’ aber ihren Namen vergessen.

*The travelers demanded that a trip to the Baltic Sea be offered, and then, in fact, a bus driver drove every traveller to the Baltic Sea. But I forgot her name.*

(13) **Jeweils (= binominal each)**: Q-SR ⇒ no, Q-IR ⇒ yes

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2 This decision may introduce another potential confound: when participants see a plural DP in the context, they may be biased to respond to the plural Q-IR with Yes and to Q-SR with No. However, it is impossible to avoid this problem. It is necessary to introduce the two DPs in the preceding context to control for information structure, but as soon as we do so we must decide for either the singular or the plural form, thereby induc- ing a bias in either direction. We therefore opted for the number-neutral (bare) plural form, which is less likely to induce a bias.

3 As mentioned further above, the items were written in a more colloquial style to mask the use of the abbreviated indefinite, e.g. by writing *ham* for *haben* (= have) or *solln* for *sollen* (= shall/should).*
Die Mieter im Erdgeschoss ham gedroht, ’ne Beschwerde aufgrund des Schlagzeugs im ersten Stock einzureichen, und tatsächlich ham sie dann auch jeweils ’ne Beschwerde eingereicht.

The tenants on the ground floor threatened to file a complaint about the drums on the 1st floor, and then, in fact, they each filed a complaint.

(14) Universal preceding existential: Q-SR ⇒ no, Q-IR ⇒ yes

Der Arzt hat angewiesen, dass die Krankenschwestern von Pflegern unterstützt werden solln, und tatsächlich hat dann jeder Pfleger ’ne Krankenschwester unterstützt.

The doctor ordered that the nurses should be supported by care-givers, and then, indeed, each caregiver supported a nurse.

Procedure: The experiment was conducted online with the free software OnExp. The experiment included in total 48 target items and 48 filler/controls, presented one after another in randomized order. Participants could choose to take a break in the middle of the experiment or whenever they felt tired. Participants were told that there were no right or wrong answers, and they were encouraged to answer the questions on the basis of their own intuition about the individual sentences. 70 students were recruited via the participant pool of University of Potsdam (SONA), and they could carry out the experiment for a monetary compensation of 8 EUR or for course credit. Three of the 70 participants were excluded from the analysis for answering less than 2/3 of the unambiguous control items correctly. The remaining 67 participants were within an age range of 17–58 and had a mean age of twenty-four years. 59 of them were female and 8 of them were male. All of them were native speakers of German.

2.2. Predictions

None of existing accounts of German quantifier scope predicts inverse scope readings to be available for the sentence structures investigated in the experiment. We now explain the theoretical reasoning behind the predictions of each account.

Frey (1993) restricts inverse readings to contexts in which reconstruction is possible, that is, contexts in which overt movement has occurred. However, our target sentences all occur with canonical subject-before-object word order, excluding the possibility of reconstruction.

4 Strictly speaking, this condition was not unambiguous since there are still two QPs that can take scope over each other. However, in this order, the universal has a very strong tendency to take wide scope since it is preferably interpreted as distributive. Additionally, the inverse ∃∀-reading entails the surface ∀∃-reading so that it can be constructed as a special subcase of the surface ∀∃-reading; cf. Reinhart (2006) for extensive discussion. As can be seen in the results section in Chapter 2.3, items in this condition were indeed treated as unambiguous, as expected.

5 As indicated above, Frey’s account does not make a concrete prediction for our concrete target sentences since these contain expressions that are not truly quantificational according to Frey. However, as discussed above, it is not clear to us that there is a categorical distinction in the referential potential of such QPs and the bona fide quantifiers used by Frey (1993), and the use of the reduced weak indefinite form ’ne further diminished the risk of a non-quantificational referential interpretation for the ∃-subject QP. For these reasons, we will continue to treat ’ne and jeder as bona fide quantifiers, as is standardly done in in the literature on quantifier scope in English; see e.g. May (1977), Fox (2000), Reinhart (2006), among many others.
We would therefore expect participants to only answer with ‘yes’ to Q-SR, which targets the surface ∃∀-reading, but ‘no’ to Q-IR for the inverse ∀∃-reading. This prediction holds across all six conditions since the linear order and hierarchical relationship of subject and object does not change. Thus, neither the factor plausibility nor the factor embedding should have an impact on the expected response patterns.

Pafel’s (2005) account is based on a multitude of factors with a cumulative impact on scope interpretation. In (15), we present the values for the different factors listed in Pafel (2005) for the syntactic configuration in our target sentences.

(15) … und tatsächlich hat dann ’n breiter Kanal jedes Feld bewässert.
... and then, indeed, a wide canal irrigated every field.

QP1 (∃-subject): linear order: 1.5x5 + grammatical function: 1x5 = 12.5
QP2 (∀-object): distributivity: 1x5 = 5

The ∃-subject QP1 has the advantage of linear order because it precedes the ∀-object QP, and of its grammatical function because, as the subject, it is more prone to take wide scope than the object. The ∀-object QP2 only has the advantage of being inherently distributive. The difference between the two values is 7.5, which is greater than five. Therefore, the sentence should be unambiguous with QP1 taking wide surface scope over QP2. Since the factors listed by Pafel remain stable across our six conditions, we expect the same answer pattern throughout. Additionally, Pafel takes QPs to be phrase-bound, which would only strengthen the unavailability of the inverse reading in the two embedding conditions. Since Pafel’s account is multifactorial, it might always be possible to add further factors to the system, should these factors turn out to play a role in interpretation. Therefore, a difference between the neutral and the IR-biased condition in the 0-emb sentences might be consistent with Pafel’s account if we were to include a context factor of plausibility in the system.

Finally, Bobaljik & Wurmbrand’s (2012) account is based on the covert syntactic operation of Quantifier Raising and on the soft economy constraint ScoT. It predicts that inverse readings in German are unavailable in most syntactic configurations, namely whenever overt movement is licit in order to satisfy ScoT. Inverse readings should hence be available only in special contexts in which overt movement is ruled out by general syntactic constraints or in which ScoT stands in opposition to other, e.g. information-structural constraints. However, the grammaticality of (16) shows that overt movement is possible in our target sentences.

(16) Die Polizei hatte vor dem Sturm davor gewarnt, dass die Wege in die Innenstadt durch Bäume blockiert werden könnten, und tatsächlich hat dann jeden Weg ’n Baum t1 blockiert.

The police warned before the storm that the access roads to the city centre could be blocked by fallen trees and then, indeed, a fallen tree blocked every access road.

In fact, as already argued above, overt movement should even be preferred for information structural reasons, as it would give rise to a topic-before-focus sequence: after all, the

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6 We changed the word ‘Zufahrt’ (= entrance) to ‘Weg’ (= way) for this example in order to avoid garden path effects due to case ambiguity with feminine nouns in German.
contextually salient set of access roads denoted by the DP die Wege ‘access road’ seems to be the aboutness topic of both context and target sentence. Thus, we can exclude the possibility that there is any pressure from information structure that would counter the effect of ScoT by forcing the canonical word order, quite unlike in cases of inverse scope with canonical word order under the rise-fall contour discussed in Krifka (1998). Given all of this, the account in Bobaljik & Wurmbrand (2012) also predicts inverse readings to be unavailable for our target sentences. In addition, their account is purely structural in that pragmatic plausibility considerations are not mentioned as a potential constraint triggering a violation of ScoT. Therefore, the account does not predict a difference between the neutral and the IR-biased condition. Additionally, same as in Pafel’s account, the two embedding conditions should likewise block inverse readings from occurring, as the syntactic movement operation of QR cannot apply across island boundaries. However, given that their account does not predict any yes-answers to the IR-question in the 0-emb condition to begin with, the answer patterns should be stable across the three embedding conditions: Q-IR should be consistently answered with ‘no’.

2.3. Results

The descriptive results of the experiment are shown in Figs. 1 and 2. Fig. 1 shows the proportion of yes-responses when participants were asked for the surface reading with Q-SR. Fig. 2 shows the same for Q-IR targeting the inverse reading. Table 1 gives the numbers for the filler/control conditions. As can be seen in Table 1, participants behaved as expected on all five filler/control conditions in overwhelmingly opting for the single available interpretation (between 89% and 95%). This shows that our experimental design is ecologically valid and yields reliable results.

7 In addition, the filler/control conditions allow us to gauge the level of expected variability, which is presumably due to confounding non-linguistic factors beyond experimental control, such as e.g. inattention or tiredness of the participants or accidental incorrect choices on the keyboard. As the acceptance rating for the unavailable readings vary between 8% and 12%, we set the threshold of expected variability at about 10%.
Looking at Fig. 1, we see that participants accepted the surface reading in 82% of the cases in neutral contexts without embedding (neutral/0-emb), whereas the inverse reading was still accepted in 39% of the cases. When the target sentence was embedded in a relative clause (1-emb), the surface reading was accepted in 88% of all cases, whereas acceptance of the inverse went down to 21%. When the sentence was doubly embedded (2-emb), the surface reading was accepted in 92% of all cases, whereas acceptance of the inverse reading went down still further to 16%. In condition IR-biased, in which plausibility considerations biased strongly towards the inverse reading, participants accepted the surface reading in 49% of all cases and the inverse reading even in 65% of all cases without embedding. In condition 1-emb, the surface reading was available in 71% of all cases, whereas acceptance of the inverse reading was still at 50%. In condition 2-emb, the surface reading was available in 81% of all cases, and the inverse reading was acceptable in 35% of all cases.

The data was analysed in the free software R (version 3.6.1; R Core Team, 2019) with a generalized linear mixed model fit by maximum likelihood using the package lme4 (Bates et al., 2015). (17) shows the formula for the model. The factor plausibility was analysed using a treatment contrast with neutral as the baseline. The factor embedding was analysed using a sliding contrast, comparing the 1-emb to the 0-emb condition, and the 2-emb to the 1-emb condition.

(17) Formula: interpretation ~ plausibility * embedding + (1 | participant) + (1 | item)

We observed a main effect of the factor context plausibility with the IR-biased condition being significantly different from the neutral condition ($p = 2.19e-11$). We also observed a
main effect of embedding with 1-emb being significantly different from 0-emb (p = 2.92e-13) and 2-emb being significantly different from 1-emb (p = 1.21e-06) in the neutral condition. We did not find any significant interaction effects (neutral/IR-biased & 0-/1-emb: p = 0.47; neutral/IR-biased & 1-/2-emb: p = 0.19), which would have been indicative, for instance, of an absolute blocking of inverse scope readings from embedded environments.

2.4. Discussion

The uniform prediction of all three theoretical accounts quantifier scope in German from §1 was that inverse readings should be ruled out in all six conditions of our experiment. This is clearly not the case! First of all, the acceptance rates for all the conditions are way above the expected level of ~10% from the filler/control conditions. That is, the acceptance rates indicate that participants did quite frequently obtain the inverse reading, and that this was the case across all conditions. Most importantly, participants accepted the inverse reading to a considerable degree even in neutral contexts, where the surface reading was just as plausible as the inverse reading. That is, participants were not urged into that interpretation by pragmatic considerations, a finding which is at odds with proposals that inverse readings are costly and in need of pragmatic licensing by plausibility considerations (Reinhart 2006). Even though the acceptance rate for the surface reading exceeds that for the inverse reading in the neutral condition, thereby indicating that the surface reading is generally preferred, presumably on structural grounds, the inverse reading was not excluded. This can be seen, for instance, by the acceptance rate of 39% in condition neutral/0-emb.

Yet more remarkable is the finding that the acceptance of inverse scope readings did not drop to the same level as the filler/controls in the neutral embedding conditions, in which inverse readings should be ruled out for the simple reason that the lower QP is embedded in a relative clause island. Even though there is a clear effect of embedding in the predicted direction, i.e. the values decrease with ever deeper embedding, the inverse scope reading is still accepted to some degree, namely in 21% and 16% of all cases. Our findings on the embedding conditions thus pose a challenge to two common assumptions on inverse scope: assuming, first, that inverse readings are obtained via a covert movement operation of QR, and, second, that relative clauses constitute islands for movement (overt or covert), the 21% acceptance of inverse readings in the neutral/1-emb condition is surprising. This would seem to suggest that either inverse readings are not obtained via QR, or that relative clauses do not actually constitute islands for movement (for similar claims see e.g. Sauerland, 2005; Hulsey & Sauerland, 2006; Barker, 2019). Interestingly, there appears to be a third option that would allow one to maintain both assumptions, however. On Sauerland’s (2003) syntactic analysis of English relative clauses, these structures can have two different derivational histories in terms of raising or matching, where the relevant subtype for the discussion at hand is the subtype of raising relative clauses. According to Sauerland (2003), the NP-head in raising relative clauses originates inside the relative clause – somewhat comparable to overt head-internal relative clauses – from where it raises to its surface position. The empirical evidence for this came from reconstruction effects with condition A. Notice that the relative scope dependency in our embedding conditions was always between an existential head-NP and a ∀-object inside the relative clause. If so, relative clauses might very well allow for inverse readings, at least in this particular configuration, given that the existential head NP
can reconstruct to its base position inside the relative clause; see also Fox (2000) on quantifier lowering. In a second step, the ∀-object QP could move to a position c-commanding the reconstructed ∃-subject QP inside the relative clause. Both steps are schematically shown in (18ab).

(18)  
  a. **Step 1: Reconstruction**
  There was [a drone] [which [a drone] surveilled every building].
  
  b. **Step 2: Quantifier Raising**
  There was [a drone] which [every building] [a drone] surveilled [every building].

Since two covert movement operations are required for deriving the inverse reading in (18), such readings would be costly and predicted to occur only rarely, if at all. In any event, their generation would be supported by plausibility considerations, which appears to be reflected in the much higher acceptance rates in conditions IR-biased/1-emb and IR-biased/2-emb. On a more sceptical note, though, it is questionable whether participants will posit such complex derivational histories in the absence of structural or pragmatic evidence, i.e. when the surface reading is easily available as an alternative and less costly reading; but see Wurmbrand (2018) for syntactic derivations of inverse scope from embedded clauses that also involve three derivational steps. Additionally, it is not clear that the raising structure postulated for English relative clauses is also found with German relative clauses. We will therefore delegate this issue to future research.

As for the importance of world knowledge and plausibility considerations, these factors were largely ignored by treatments of quantifier scope in German. The general prediction was that inverse readings should be unavailable in the structural configuration under discussion, independent of context. The reasoning behind this is as follows: if inverse scope readings are ruled out on general structural grounds, for instance scope rigidity, then an IR-biasing context should not be able to save them. However, we have seen that inverse readings are in principle available between ∃-subject QPs and ∀-object QPs. Given this, and assuming that inverse scope readings are more costly to compute than surface readings (Reinhart 2006, Wurmbrand 2018), it is not surprising that the change of context from neutral to IR-biased had a strong effect on interpretation. In fact, IR-bias induced a preference for the inverse reading over the surface reading in the 0-emb condition. More generally, the acceptance rate of inverse readings under IR-bias is consistently higher than in neutral contexts across all conditions. The effect of IR-bias is thereby visible even in the embedding contexts, which disfavour the inverse reading on structural grounds. Form a cross-linguistic perspective these results are in line with previous work on quantifier scope in English, which assigned context and world knowledge an important role in the interpretation of scope ambiguities (e.g. Kurtzman & MacDonald 1993, Villalta 2003, Anderson 2004, Reinhart 2006).

Taking stock, our results are not compatible with any of the existing theoretical accounts of relative quantifier scope in German, which are all based on introspective judgments. They are, by contrast, fully compatible with previous experimental research on quantifier scope in German, which found inverse readings to be available in other structural configurations than the ones tested here, and they are also compatible with the findings in Zimmermann (1997). Moreover, our results are also compatible with introspective and experimental findings on quantifier scope in English. In sum, then, our experimental results constitute strong additional
Evidence that inverse readings – albeit dispreferred – are in fact generally available in German, same as in English. Contrary to received wisdom, this opens up the possibility that the difference in quantifier scope potential between English and German is more gradual than categorical in nature.

3. By-Participant Variability

Closer analysis of the results also revealed a high variability in by-participant behaviour. This is illustrated in Figure 3, in which the rows in the diagrams show the response patterns of individual participants.

![Figure 3: proportions of ‘yes’ (grey) and ‘no’ (black) in percentage by participants across all four 0-emb conditions.](image)

The patterns are relatively stable across participants in the neutral condition with Q-SR targeting the surface reading (leftmost diagram), suggesting that the surface reading is available for the majority of participants. In all other conditions, by contrast, the response patterns are much more varied, as shown by the different distribution of ‘yes’-answers (in grey) and ‘no’-answers (in black) across participants. In fact, proportions of yes-responses are spread across the whole scale from 0 to 100%. This shows that for a given condition, some participants showed across-the-board acceptance and others showed across-the-board rejection of inverse scope and surface scope reading, respectively. Taking a closer look at the participants’ individual behaviour across all conditions, there appear to be different interpretation strategies at play. Table 2 gives an overview of the prototypical behavioural patterns that could be observed, together with the rough number of participants falling into each category.

<table>
<thead>
<tr>
<th>prototypical pattern</th>
<th>strategy</th>
<th>availability of IR</th>
<th>number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pragmatic</td>
<td>available</td>
<td>~17</td>
</tr>
<tr>
<td>2</td>
<td>pragmatic</td>
<td>not available/</td>
<td>~12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dispreferred</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Visually extracted patterns of participants' interpretation strategies in the 0-emb conditions

<table>
<thead>
<tr>
<th></th>
<th>syntactic</th>
<th>available</th>
<th>~8</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>not available</td>
<td>~13</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>dispreferred</td>
<td>~10</td>
</tr>
<tr>
<td>6</td>
<td>unclear</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The majority of participants (60/67) could be assigned to one of these categories. We extracted two parameters that seem to play a role: first, for some participants (groups 2, 4, 5) the inverse reading seems to be categorically ruled out or extremely dispreferred, while for others, the inverse reading is generally an option (groups 1,3). Notice that it is a valid hypothesis that the authors of the introspection-based accounts of quantifier scope in German belong to this category as well. Second, some participants seem to be more syntactically driven, while others are more pragmatically driven. We will exemplify this difference by looking at groups 1 and 4 in Table 3. The participants in group 1 (almost) always responded to Q-IR targeting the inverse reading with ‘yes’, independent of context. In contrast, they (almost) always responded to Q-SR with ‘no’ in the IR-biased context and (almost) always ‘yes’ when the context was neutral. We categorized these participants as pragmatic-driven, since context has a clear impact: when a reading is plausible, it is accepted; when it is not plausible, it is rejected. Additionally, we say that for these participants the inverse reading is generally available, since they accept it even in the neutral context, in which acceptance of inverse readings is not forced by plausibility considerations. The participants in group 4, by contrast, always accepted the surface reading and they always rejected the inverse reading, independent of context. We consider these participants syntactically driven, as context has no impact on their observable response behaviour. In addition, the inverse reading is generally unavailable for them, because they even rejected it under IR-bias, in which the inverse reading was the more plausible interpretation. Notice, though, that the number of items per condition and participants was low and that we did not run a statistical analysis on by-participant variability. Therefore, the categorization in Table 3 has to be taken with caution, and they should be explicitly targeted in a separate experiment.

The more general question that arises from the observed by-participant variability is why it should exist at all. It is a common, though perhaps incorrect, assumption that speakers of the same language share the same grammar. They could therefore be expected to interpret sentences in a similar manner. Quantifier scope, too, is a linguistic phenomenon that is standardly considered to be driven by the syntactic properties of a given language. This expectation clashes with our results, which exhibit a range of possible response patterns, from one extreme to the other. One way of accounting for this quite drastic variability would be to say that speakers of the same language, or even the same dialect, exhibit micro-variation regarding subtle and relatively infrequent grammatical phenomena such as quantifier scope.
While most rules of grammar are shared, intuitions may well differ on more marginal phenomena. Alternatively, or additionally, the variation may also be accounted for by postulating transfer effects and differing exposure to other languages. In English, for instance, inverse readings are generally claimed to be more easily available than in German. Some studies have shown that it is possible for L2-learners to learn the scope properties of the target-language even when they differ from the native language (Marsden, 2004; Lee, 2009). Thus, scope preferences may not be fixed but may well change in response to different language exposure. It is therefore conceivable that participants could differ in their proficiency of English, thereby exhibiting different degrees of transfer effects. Finally, it is possible that quantifier scope is a phenomenon that is not so much affected by grammatical constraints but has more to do with processing abilities. In fact, inverse scope is typically described to be more costly (e.g. Reinhart, 2006; Kurtzman & MacDonald, 1993). The variable response patterns might thus be a consequence of different levels of processing abilities. These possibilities should be investigated in future experiments.

4. Conclusion

We presented the results of an offline behavioural experiment on quantifier scope in German that provides strong evidence that inverse scope readings are in fact available in German – albeit dispreferred. These findings stand in stark contrast to the existing theoretical literature on quantifier scope in German, which is largely based on introspection data (Frey, 1993; Pafel, 2005; Bobaljik & Wurmbrand, 2012). We also showed that both context plausibility and island embedding have a strong effect on scope interpretation. Interestingly, the data suggests that inverse scope readings are not completely banned from relative clause islands. Our experiment also showed that speakers of the same language exhibit highly variable behaviour when it comes to the interpretation of relative quantifier scope. This variability is likely not random, as it appears to be driven by different interpretation strategies which give higher priority to structural or pragmatic considerations (plausibility), respectively.

References


Most, but not more than half, is proportion-dependent and sensitive to individual differences

Sonia RAMOTOWSKA — Institute for Logic, Language and Computation, University of Amsterdam
Shane STEINERT-THRELKELD — Department of Linguistics, University of Washington
Leendert VAN MAANEN — Department of Psychology, University of Amsterdam
Jakub SZYMANIK — Institute for Logic, Language and Computation, University of Amsterdam

Abstract. In this study we test individual differences in the meaning representations of two natural language quantifiers – most and more than half – in a novel, purely linguistic task. We operationalized differences in meaning representations as differences in individual thresholds which were estimated using logistic regression. We show that the representation of most varies across subjects and its verification depends on proportion. Moreover, the choice of the representation of most affects the verification process. These effects are not present for more than half. The study demonstrates the cognitive differences between most and more than half and individual variation in meaning representations.

Keywords: generalized quantifiers, most, more than half, individual thresholds, meaning representations, verification strategies.

1. Introduction

Imagine that there are three candidates in an upcoming election: candidates A, B and C. To win the election the candidate needs most of the votes. How would you check if the sentence “Most of the people voted for candidate A” is true? You can represent this sentence in many ways. You can, for example, think that the number of people who voted for candidate A is greater than half of all of the votes or alternatively that the number of people who voted for candidate A is greater than the number of people who cast for their votes on other candidates.

In the literature (e.g. Lidz, Pietroski, Halberda, & Hunter, 2011; Pietroski, Lidz, Hunter, & Halberda, 2009; Tomaszewicz, 2013) there are several proposals how the meaning of most can be represented:

(1) Representations of most
   a. most(votes in election, votes on A) ⇔ |votes on A| > ½|votes in election|
   b. most(votes in election, votes on A) ⇔ |votes on A| > |votes on not-A|
   c. most(votes in election, votes on A) ⇔ OneToOnePlus(votes on A, votes on not-A)
   d. most(votes in election, votes on A) ⇔ |votes on A| > |votes on B| + |votes on C|
   e. most(votes in election, votes on A) ⇔ |votes on A| > |votes in election| - |votes on A|

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For example, if you represent the meaning of *most* as in (1c), you have to pair each vote cast for candidate A both with votes for either candidate B or C. If you find at least one vote for candidate A left unpaired, then candidate A will win.

According to the Interface Transparency Thesis (Lidz et al, 2011: 233): “The verification procedures employed in understanding a declarative sentence are biased towards algorithms that directly compute the relations and operations expressed by the semantic representation of that sentence”. Although some studies (Pietroski et al., 2009; Lidz et al., 2011) support the Interface Transparency Thesis, there is also evidence that people might prefer different verification strategies (Steinert-Threlkeld, Munneke, & Szymanik, 2015; Talmina, Kochari, & Szymanik, 2017; see for overview: Szymanik, 2016). In this paper, we will present findings demonstrating that there are individual differences in the representation of natural language quantifiers (expressions like: *most, more than half, fewer than half, many, few, some, all, at least*). We will show evidence for individual differences in meaning representations with a special focus on two natural language quantifiers: *most* and *more than half*.

1.1. Most and more than half

*Most* and *more than half* are examples of truth-conditionally equivalent quantifiers, that differ in many other aspects, e.g., they seem to trigger different verification strategies (Hackl, 2009) and have different pragmatic associations (Solt, 2016). Generalized Quantifier Theory (GQT, Mostowski, 1957; Barwise & Cooper, 1981; Peters & Westerståhl, 2008; Szymanik, 2016) is not able to distinguish between expressions that are logically equivalent, but generate different linguistic intuitions.

According to Hackl’s (2009) linguistic analysis, *more than half* is a comparative expression, while *most* is the superlative form of *many* (i.e. MANY+EST). However, under this analysis *most* also satisfies proportional truth-conditions. In contrast, the opposite quantifier to *most* – *fewest* – has only a superlative reading. The lack of proportional reading for *fewest* cannot be explained on the grounds of GQT but falls out naturally from Hackl’s analysis.

According to Hackl (2009) the linguistic differences between *most* and *more than half* are reflected in different basic logical representations of these quantifiers.

(2) Logical representations of *most* and *more than half*

a. \( \text{most}(A, B) \iff |A \cap B| > |A - B| \)

b. \( \text{more than half}(A, B) \iff |A \cap B| > \frac{1}{2}|A| \)

Although both logical forms satisfy the same truth-conditions and thus are indistinguishable from the perspective of GQT, they may trigger different cognitive verification strategies. The verification of *more than half* requires the comparison of cardinality of the target set \(|A \cap B|\) to half of the size of A \((\frac{1}{2}|A|)\), while the verification of *most* requires comparison between the cardinality of the target set \(|A \cap B|\) and the cardinality of the complement set \(|A - B|\).

2 Pietroski et al (2009) and Lidz et al (2011) provided evidence that the verification strategy for *most* should be \( \text{most}(A, B) \iff |A \cap B| > |A| - |A \cap B| \).
Hackl (2009) supported his linguistic analysis with experimental data. Using a novel paradigm – Self Paced Counting – he argued that most is verified using a vote-counting strategy. In this experiment, he did not find a difference in overall reaction times and accuracy between most and more than half. Hackl (2009) argued that this lack of differences is evidence that participants treated most and more than half as equivalent expressions. To summarize, Hackl (2009) argued that most and more than half are verified using different strategies, but that these two quantifiers are truth-conditionally equivalent and therefore they are both true above 50% proportion and false below.

In contrast to Hackl’s (2009) findings, other studies (Talmina et al., 2017; Kotek, Sudo, & Hackl, 2015) showed that participants might not treat most and more than half as equivalent quantifiers. Firstly, in a replication study, Talmina et al. (2017) found that more than half is verified slower than most. This finding questions Hackl’s (2009) argument that participants treated most and more than half as equivalent quantifiers. Moreover, Talmina et al. (2017) suggested that subjects might have used various verification strategies for both quantifiers. Talmina et al.’s (2017) findings suggest a more complex picture, showing that people might differ in their representation of quantifiers.

Secondly, Kotek et al. (2015) support the hypothesis that most and more than half have different meaning representations. They found a difference between most and more than half in terms of their sensitivity to proportion. While more than half was judged equally likely as false for proportions below 50% and true for proportions above 50%, most exhibited an asymmetry. It was judged true for proportions above 50% less often than more than half. Kotek et al. (2015) concluded that the asymmetry between most and more than half for proportions above 50% might be explained by pragmatic associations of these quantifiers (Solt, 2016).

In particular, Solt (2016) explained the differences between most and more than half in terms of their scale structure requirements. More than half requires precise comparison, which is only possible on a ratio scale. Most has lower scale requirements and can be verified on a semi-ordered scale. On a semi-ordered scale, one of the two proportions to be compared is greater than another, when it is greater by some value. The semi-ordered scale allows only for imprecise, approximate comparisons. As a consequence, most has a preferred interpretation of “significantly greater than more than half”.

The differences in required scale structure for most and more than half are reflected in their pragmatics (Solt, 2016). Solt (2016) found, in corpus data, that most is used with higher proportions or in the context, in which the precise comparison is not possible. More than half, in turn, expresses proportions slightly above 50% and occurs in the context, in which the precise data are available. Although Solt (2016) found clear differences in usage of most and more than half, she used corpus data that does not provide evidence for differences in processing and verification of these quantifiers. Therefore, based on her findings, it is not possible to know whether the differences between most and more than half should be attributed to semantics or rather to the pragmatics of these quantifiers.
Solt’s (2016) claim that most has a strong “significantly more than half” interpretation was supported by other studies (Ariel, 2003; Pezzelle, Bernardi, & Piazza, 2018). For example, Ariel (2003) found a similar pragmatic tendency to use most with the higher proportions than more than half in a questionnaire study. Moreover, she argued that most and more than half are semantically different. Most is an upper-bounded quantifier, while more than half has no upper-bound. In addition, Pezzelle et al. (2018) investigated the meaning boundaries of several quantifiers, among others most. They asked the subjects to select, from a restricted choice, a quantifier that best describe a given scene. They found that most was used for proportions between 40% and 100% with a peak around 70%. Its usage highly overlapped with many, however most was chosen more often. Unfortunately, Pezzelle et al. (2018) have not studied more than half so the direct comparison between these two quantifiers on the selection task is not available.

To summarize, the strong preferences to use most with higher proportions stands in conflict with the treatment of most as a quantifier with a 50% threshold. It also raises a question if most has only one possible representation – truth-conditionally equivalent to more than half. The existing evidence suggests that there are differences between most and more than half, which might result in the differences in thresholds in these quantifiers. While more than half has a clear threshold, the threshold for most might vary between 50% and higher proportions. According to the truth conditions, most should have the same threshold as more than half. However, experimental evidence (Kotek et al, 2015) and corpus data (Solt, 2016) suggest that most can also have a higher threshold. The fact that most has two possible interpretations raises the question of whether this quantifier is represented in the same way by all language users. Only a few studies (e.g. Yildirim, Degen, Tanenhaus, & Jaeger, 2016; Talmina et al, 2017) investigated individual differences in quantifiers. Because quantifiers like most are sensitive to different interpretations, it might be also possible that people differ in how they represent quantifiers.

Thus, the question arises: are the differences between most and more than half outlined above reflected in individual differences in thresholds? Before presenting our methods for answering this question, in the next section we review studies showing that individual differences in natural language are widespread.

1.2. Individual differences in natural language

Individual differences in natural language are exhibited in many phenomena related to variation in performance of cognitive functions such as working memory and executive function (Kidd, Donnelly, & Christiansen, 2018), environmental variables (Kidd et al., 2018) or efficiency in updating predictions (Reuter, Emberson, Romberg, & Lew-Williams, 2018). They are present in many domains of language processing: morphosyntactic processing (Tanner & Van Hell, 2014), language production (Barlow, 2013), representation of words in context (Halff, Ortony, & Anderson, 1976), understanding of grammar constriction (passive voice) and universal quantification (Street & Dabrowska, 2010), among others. Individual differences are also characteristic for language disorders like dyslexia (Heim et al., 2008) or dysgraphia (Döhla, Willmes, & Heim, 2018).
In contrast, only a few studies have investigated individual differences in meaning representations. Talmina et al. (2017) found that some people use precise verification strategies for quantifiers, while others use estimation-based strategies. Furthermore, Yildirim et al. (2016) showed individual differences in listeners’ expectations about the speaker’s interpretation of quantifiers. Speakers can also adjust their representation of the quantifier meaning to the listener (Yildirim et al., 2016) or learn a new representation of a quantifier (Heim et al., 2015). Heim et al. (2015) showed that change in representation of one quantifier affects other quantifier representations: for example, a change in the representation of many affects the representation of few.

In addition, studies investigating the scalar implicature some-not all (e.g. Bott, Bailey, & Grodner, 2012; Spychalska, Kontinen, & Werning, 2016) show that people can be grouped with regards to their preferences in interpretation of natural language quantifiers into so-called pragmatic or logical responders. The logical responders tend to interpret some according to its semantic, literal meaning: some As are B iff the number of As than are B is greater than zero. This interpretation includes also the possibility that all As are B. The pragmatic responders, in turn, judge sentence some As are B as false if in fact all As are B. This division is also reflected in differences in ERPs N400 and late positivity between two groups of responders (Spychalska et al., 2016).

1.3. Current study

The current study tests the effect of individual differences in representations of the quantifiers most and more than half. We operationalized the individual differences in quantifier representation as individual thresholds. We asked participants to verify a sentence with quantifiers based on proportion, given as a percentage. We used quantifiers that intuitively varied in sharpness of their meaning boundaries: more than half, fewer than half, most, many and few. We used proportions given as percentage in order to force a proportional reading for all quantifiers. We formulated the following predictions.

According to GQT, most and more than half are truth-conditionally equivalent and therefore, should have the same threshold: 50%. Moreover, there should be no difference in the interpretation of these quantifiers between participants. In contrast to GQT, previous studies (Solt, 2016; Ariel, 2003; Kotek et al., 2015) showed most has also the “significantly greater than more than half” interpretation and it is dispreferred with proportions around 50%. These findings give a prediction that the threshold for most should be higher than the threshold for more than half. Finally, the number of studies (Yildirim et al., 2016; Talmina et al., 2017) showed that quantifiers, like other natural language expressions, are sensitive to individual differences in representation. We hypothesized that participants might vary in terms of which reading of most they prefer. Therefore, we predicted that:

(H1) Participants will have different representations for most and more than half.

Following Hackl (2009) we assumed that the choice of the verification strategy depends on the cognitive representation of the quantifier. Moreover, according to Solt (2016), most is verified using an imprecise, estimation-based strategy. Pietroski et al. (2009) and Lidz et al.
(2011) showed that the usage of the estimation-based strategy results in proportion-dependent performance. However, they did not contrast the proportion-dependent performance of *most* with *more than half* and so we cannot conclude that the effect they found was a consequence of linguistic properties of *most* rather than the task design. We directly compared the effect of proportion on speed of verification (reaction times) between *most* and *more than half*. Following Pietroski et al (2009) we hypothesized that when the proportion is close to 50% the verification of *most* should be more difficult. We predicted that:

(H2a) The verification of *most*, but not *more than half*, is proportion-dependent.

We also aimed to see if we can capture the effect of variation in representations between participants in their reaction times. We assumed that if participants have different representations of quantifiers, they also use different verification strategies. Therefore, we predicted that:

(H2b) Differences in representation will be reflected in differences in verification speed.

2. Methods

2.1. Participants

We collected data from 90 subjects. After exclusion criteria were applied, the final sample consisted of 47 male (*M* = 35, *SD* = 11, range: 22-59) and 24 female participants (*M* = 34.5, *SD* = 10, range: 22-59). 6 female and 18 male participants graduated high school, 6 female and 15 male subjects finished high school education and started college, 12 female and 14 male participants graduated college or obtained higher degree. Each participant received 4 US$ for participation. The study was a part of the project that received European Research Council and University of Amsterdam, Faculty of Humanities Ethics Committee ethical approvals.

2.2. Design

Participants were presented two sentences. The first sentence was of the form “Q of the As are B”, where Q was one of the quantifiers: *most*, *more than half*, *many*, *fewer than half*, *few* and As and Bs were pseudowords generated with the Wuggy software (Keuleers & Brysbaert, 2010) from English 6 letters adjectives and nouns. An English native speaker assessed pseudowords; we excluded them if they were too close to real English words or did not sound like plausible English words. 50 pseudo-adjectives and 50 pseudo-nouns were chosen and randomly paired. We checked frequency (Zipf value) of the original adjectives and nouns in SUBTLEX-US database (van Heuven, Mandera, Keuleers, & Brysbaert, 2014). The Zipf value of final lists were both 4.06. Each quantifier occurred with each pair of pseudowords only once and in a random order.

The second sentence presented to participants was of the form “p% of the As are B”, where As and Bs were the same pseudowords as in the first sentence and p% was a randomly
generated proportion form 1% to 99%, excluding 50%. In the case of *most, more than half* and *fewer than half*, the proportions above and below 50% were counterbalanced within participants. Because *most* does not have a clear upper boundary (Ariel, 2003) we did not include the proportion 100%.

2.3 Procedure

Our experiment was conducted on Amazon Mechanical Turk. Participants had to decide if the first sentence is true based on information from the second sentence. They were presented 250 pairs of sentences, 50 per each quantifier. Firstly, they had to press the arrow down button and keep it pressed as long as they wanted to see the first sentence on the screen. Secondly, they had to press arrow down button again to read the second sentence with proportion. Finally, they had to choose the arrow left or arrow right buttons for true or false response. The response buttons were balanced between-subjects.

Before the proper experiment started, participants practiced the procedure for 8 trials in a training block. In the training block we used the quantifiers *some, all*, and *none* in the first sentence. At the end of the experiment participants were asked to provide basic demographic information (e.g., gender, age, education background).

2.4. Preprocessing reaction times (RT) data

Before we estimated individual thresholds we excluded reaction times shorter than 300 ms and longer than mean+2SD for each quantifier and true/false responses separately.

2.5. Logistic regression model

In order to estimate participants’ individual thresholds we applied logistic regression using R *nls* self-starting function (Bates & Chambers, 1992):

$$P(T) \sim \frac{1}{1 + e^{(p_0 - p)/s}},$$

with starting values: $p_0 = 50$, $s = 4$ for *most, more than half* and *many*, and $p_0 = 41$, $s = -5$ for *few* and *fewer than half*.

$P(T)$ indicates the probability that a participant provided a “true” response, and $p$ the percentage introduced on every trial. The estimated parameters were $p_0$ – participant individual threshold – and $s$ – the steepness of logistic regression curve.

The individual threshold could not be estimated using the *nls* function if a participant’s “true” and “false” responses did not overlap. In those cases, we computed thresholds as the average of the highest proportion for which a participant responded “false” and lowest proportion for which he or she responded “true” (vice versa for *few* and *fewer than half*).
3. Results

3.1. Excluded participants

We excluded 11 participants, who had 50% or more responses below 300 ms. Additionally, we ran the \textit{glmer} function in the R package \textit{lemrTest} (Kuznetsova, Brockhoff, & Christensen, 2017) separately for each quantifier, with random slope for each participant. The random slopes indicate whether the probability of response “true” increases or decreases with increasing proportion. We assumed that the random slope for quantifier most, more than half and many should be positive and for fewer than half and few negative. We excluded 6 participants, who did not meet this criterion. Finally, we excluded two participants from further analysis because their estimated threshold was higher than 100% or lower than 0%.

3.2. Individual thresholds

We estimated individual thresholds for each quantifier. Figure 1 presents individual thresholds distributions among quantifiers and summarizes descriptive statistics of thresholds. The mean accuracy for all quantifiers above and below threshold was high: many 95%, most 96%, more than half 97% both above and below threshold, and few and fewer than half 94% above threshold and 90% below threshold. The mean reaction times above thresholds were: many 991.88 ms (sd = 384.51), most 1025.06 ms (sd = 502.67), more than half 925.28 ms (sd = 342.48), few 1081.76 (sd = 421.89) and fewer than half 1068.96 (sd = 374.52). The mean reaction times below thresholds were: many 1097.24 (sd = 421.21), most 1035.28 (sd = 434.23), more than half 942.25 (sd = 306.84), few 1181.70 (sd = 425.60), fewer than half 1172.03 (sd = 475.01).

We tested if there are differences in mean individual thresholds between quantifiers. We found a significant main effect of threshold ($F_{4,345} = 9.21, \ p < 0.001$). After applying Bonferroni correction on the significance level, we found that the mean threshold for few was lower than the threshold for the other quantifiers; the mean threshold for many was lower than for most, more than half and almost significantly lower ($p = 0.056$) than for fewer than half; and the threshold for fewer than half was lower than the threshold for most. Importantly, the mean threshold for most was higher than the threshold for more than half.

A Kolmogorov-Smirnov test revealed that the distribution of thresholds is different for most and more than half ($D = 0.30; \ p < 0.01$).

Taken together the results show that most has a higher threshold than more than half, but also that participants differ in their representation of most. While in the case of more than half almost all participants had a threshold of 50%, in the case of most some participants had a threshold between 50-70%.
Figure 1: Histograms present individual thresholds distribution in each quantifier. The dashed lines indicate 50%, the solid lines indicate mean individual threshold. The mean threshold for many is 44% (sd = 10), few 39% (sd = 8), fewer than half (FTH) 48% (sd = 7), most 53% (sd = 6), more than half (MTH) 50% (sd = 4).

3.3. Proportion effect on reaction times

To understand the effect of proportion on reaction times, we re-coded all responses relative to individuals’ thresholds. We coded “true” responses that are above the individual threshold and “false” responses that are below the threshold as correct responses. We ran a mixed effect regression model (R package lmerTest; Kuznetsova et al., 2017) with reaction times as dependent variable and quantifiers (most, more than half), proportion (z-scored) and responses (true/false) and their interactions as predictors. Firstly, we tested the random effects structure. Following Barr, Levy, Scheepers, & Tily (2013), we tried to keep the random structure maximal until the model converged. We used the best path forward algorithm and included random slopes that significantly improved the model (tested by anova function in R; see Appendix A). If two random slopes were significant, we included the one that had lower p-value. To this model we included by-subject random intercept and by-subject random slope for proportion. We used more than half as baseline.

Secondly, we tested the significance of the fixed effects. Table 1 and Figure 2 summarize the effects. Here we focus on the most important one. We found no significant effect of proportion ($\beta = -22.16; t = -0.96; p = 0.34$), but a significant quantifier-proportion interaction ($\beta = -133.18; t = -3.99; p < 0.001$), meaning that the proportion had greater effect on RTs in case of most than more than half. Additionally, we found a significant main effect of quantifier ($\beta = 216.82; t = 6.43; p < 0.001$).
This finding shows that, in contrast to *more than half*, the verification of *most* is dependent on proportion, meaning that the verification is slower when the proportion is close to 50%.

Table 1: The summary of regression models comparing the effect of proportion between *most* and *more than half*.

<table>
<thead>
<tr>
<th>Effect</th>
<th>estimates</th>
<th>t value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>947.15</td>
<td>26.28</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Prop</td>
<td>-22.16</td>
<td>-0.96</td>
<td>0.34</td>
</tr>
<tr>
<td>Quant</td>
<td>216.82</td>
<td>6.43</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Resp</td>
<td>48.86</td>
<td>1.52</td>
<td>0.13</td>
</tr>
<tr>
<td>Prop:quant</td>
<td>-133.18</td>
<td>-3.99</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Prop:resp</td>
<td>82.96</td>
<td>2.59</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Quant:resp</td>
<td>-42.41</td>
<td>-0.94</td>
<td>0.35</td>
</tr>
<tr>
<td>Prop:quant:resp</td>
<td>237.40</td>
<td>5.29</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>


Figure 2: The figure presents mean reaction times for each proportion and each quantifier. The triangles correspond to responses below threshold and circles to responses above threshold. The dashed lines illustrate the model predictions for responses below threshold and solid lines for responses above threshold. The red lines for *most* are steeper indicating the proportion effect for this quantifier. For clarity of the figure we constrained the y-axis to 500-1800 ms.
3.3. Individual threshold as predictor of reaction times

In the next step we tested if the individual thresholds predict the speed of the verification process. In the regression model we used reaction times only for correct responses. We z-scored the proportion and threshold variables. We tested each quantifier separately using linear mixed effect regression model in R package \textit{lmerTest} (Kuznetsova et al., 2017). We used reaction times as dependent variable and proportion, individual threshold, response type (true/false) and their interactions as predictors. We set true responses as the baseline level. We used the same procedure to include random slopes as in model comparing proportion effect for \textit{most} and \textit{more than half}.

To test the fixed-effect structure, we used the same procedure as above: we started with the maximal model and excluded those effects that did not improve model by using \textit{anova} function in R (see Appendix A). We summarize all regression models’ coefficients in Table 2 and included detailed description of results for \textit{fewer than half, many and few} in Appendix B.

Table 2: The summary of regression models estimates with significance level (. < 0.1; * < .5; ** < .01; *** < .001) for all quantifiers.

<table>
<thead>
<tr>
<th>Effect</th>
<th>More than half</th>
<th>Fewer than half</th>
<th>Most</th>
<th>Many</th>
<th>Few</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>941.55***</td>
<td>1136.85***</td>
<td>1238.77***</td>
<td>1110.22***</td>
<td>1541.56***</td>
</tr>
<tr>
<td>Prop.</td>
<td>-18.26</td>
<td>-39.45</td>
<td>-216.17***</td>
<td>-158.04***</td>
<td>316.89***</td>
</tr>
<tr>
<td>Thr.</td>
<td>-13.99</td>
<td>15.51</td>
<td>216.98***</td>
<td>-8.13</td>
<td>-237.56***</td>
</tr>
<tr>
<td>Resp.</td>
<td>53.20*</td>
<td>-33.30</td>
<td>-67.63</td>
<td>208.57***</td>
<td>-368.56***</td>
</tr>
<tr>
<td>Prop:Thr</td>
<td>-111.36**</td>
<td>-9.46</td>
<td>-114.40**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prop:Resp</td>
<td>78.46**</td>
<td>381.99***</td>
<td>352.29***</td>
<td>-462.63***</td>
<td></td>
</tr>
<tr>
<td>Thr:Resp</td>
<td>24.47*</td>
<td>-170.40***</td>
<td>-217.42***</td>
<td>197.08***</td>
<td></td>
</tr>
<tr>
<td>Prop:Thr:Resp</td>
<td>132.66**</td>
<td>-105.31**</td>
<td>152.98***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Prop. – main effect of proportion; Thr. – main effect of threshold; Resp. – main effect of response; Prop:Thr – proportion threshold interaction; Prop:Resp – proportion response interaction; Thr:Resp – threshold response interaction; Prop:Thr:Resp – three way interaction.

\textit{More than half} We predicted that the individual thresholds should not influence the reaction times during verification of \textit{more than half}. We included by-subject random intercept. We used model comparison to determine the best model. The best model did not include three-way interaction between proportion, response and threshold ($\chi^2(1) = 0.39; p = 0.53$) and interaction between proportion and threshold ($\chi^2(1) = 2.23; p = 0.14$). As predicted, we did not find a main effect of threshold for \textit{more than half} ($\beta = -13.99; t = -0.60; p = 0.55$).

\textit{Most} We hypothesize that the individual threshold should predict the reaction times during verification of \textit{most}. We found that the best random structure of \textit{most} includes by-subject random intercept and by-subject random slope for proportion. We found a main effect of threshold ($\beta = 216.98; t = 4.20; p < 0.001$) and a significant interaction between threshold and response type ($\beta = -170.40; t = -3.61; p < 0.001$), indicating that the threshold effect was smaller for false responses. Finally, we also found a significant interaction between threshold and proportion ($\beta = -111.36; t = -3.03; p < 0.01$) and a three-way interaction between
proportion, response and threshold \((\beta = 132.66; \ t = 3.17; \ p < 0.01)\), meaning that the threshold affected the proportion effect, but only for true responses.

All together, these findings show that the individual thresholds affect the speed of the verification process in vague quantifiers e.g. most, but not in quantifiers that have a clear threshold like more than half. It is worth to mention that the effect of threshold for most was asymmetric and present only for responses above threshold.

4. General discussion

The main goal of this paper was to investigate variability of meaning representations between subjects and assessing whether most and more than half are truly equivalent. We tested differences in meaning representations by estimating individual thresholds for quantifiers. We also tested for differences in the verification process of most and more than half by looking into participants’ reaction times.

According to Hackl’s (2009) linguistic analysis, most and more than half are verified using different strategies. Following Hackl’s (2009) findings, Solt (2016) postulated that most is verified using approximate strategy. As a consequence, most should have a “significantly greater than more than half” interpretation. Solt (2016) found supporting evidence for her theory in corpus data.

Following Solt’s (2016) findings we considered most as a vague quantifier, which can have a literal interpretation, equivalent to more than half, and a “significantly greater than more than half” interpretation. To test the first hypothesis, we estimated individual thresholds using logistic regression for most and more than half and three other quantifiers: few, fewer than half and many. We found that the threshold for more than half is 50%, while in the case of most, there is higher variation in thresholds. Moreover, the mean threshold for most was higher than mean threshold for more than half. This finding clearly suggest that most is more sensitive to individual interpretation.

In contrast to our finding, Pietroski, Lidz, Hunter, Odic, & Halberda (2011) conducted additional analyses on Pietroski et al.’s (2009) data to support their claim that subjects had a 50%-threshold for most in their experiment. They investigated the deviation of accuracy from the Approximate Number System model predictions and concluded that the deviation did not increase when the ratio approached 1. The disparity between our and Pietroski et al. (2011) findings might be explained in different ways. Firstly, Pietroski et al.’s (2011) analysis is indirect and specifies only the deviation from the model predictions. In our analysis we estimated individual thresholds directly form participants responses. Therefore, our analysis does not require any additional assumptions about the correctness of the model. Secondly, Pietroski et al. (2009, 2011) ran a visual stimuli task design in a way that forced ANS performance. We, instead, gave our participants a purely linguistic task with unlimited time to provide responses. Therefore, our task is able to detect subtle differences in natural language quantifiers’ representation, while Pietroski et al. (2009, 2011)’s task confounds the linguistic effects with the influence of visual and number cognition.

The disparity between our and Pietroski et al.’s (2011) results shows the advantage of using a novel purely linguistic task. Verification processes of quantifiers are often studied using
visual stimuli (e.g. Pietroski et al., 2009; Bott, Augurzky, Sternefeld, & Ulrich, 2017; Deschamps, Agmon, Loewenstein, & Grodzinsky, 2015; Zajenkowski & Szymanik, 2013; Szymanik, 2016). For example, Pietroski et al. (2009) and Lidz et al. (2011) used a number cognition model – the Approximate Number System model (Dehaene, 1997) – to test the verification of most. We decided to use a purely linguistic paradigm, because the verification process of quantifiers against visual scene can be affected by many non-linguistic factors. For example, if the verification of quantifiers is based on ANS, then factors like type of task (Gilmore, Attridge, & Inglis, 2011; see for review: Dietrich, Huber, & Nuerk, 2015), duration of display (Cheyette & Piantadosi, 2019; Inglis & Gilmore, 2013), and set size (Dietrich, Nuerk, Klein, Moeller, & Huber, 2019) will affect the verification process regardless of quantifier representation. Therefore, we think that the verification of quantifiers should be studied also in purely linguistic tasks to test to what extent the effects found in picture tasks can be attributed exclusively to semantic processing.

It is worth stressing that although we found differences in the interpretation of most and more than half, they are not completely in line with the Solt (2016) and Ariel (2003) findings. Solt (2016) and Ariel (2003) found that most is preferred for proportions above ~65%-70%. We found that some participants had thresholds above 60% for most, but the majority of participants had a threshold lower than 60%. This might mean that Solt (2016) and Ariel (2003) captured some additional pragmatic effects on most, that pushed the threshold of this quantifier higher. In contrast, our task was very abstract (e.g., we used pseudowords) which mitigates the influence of a pragmatic interpretation on most. Moreover, Ariel (2003) tested Hebrew rov for most, while we tested English most. We cannot exclude the possibility that the differences in findings might be explained by differences in languages.

Secondly, we found that the verification of most is proportion-dependent in terms of reaction times. The verification of most takes longer when the given proportion is close to 50%. No such effect was found for more than half. These findings extend the previous studies. Pietroski et al. (2009) showed that the verification of most is dependent on proportion in terms of accuracy by using an ANS model. However, they (Pietroski et al., 2009) did not contrast most with more than half to show that these quantifiers differ in verification process.

There are at least two possible explanations of the proportion effect for most. Firstly, it might be a consequence of a difference in verification strategy. More than half is verified using a precise strategy, comparing the given proportion to 50%. In the case of most, participants had to compute the proportion of As that are not B given the proportion of As that are B. They computed the number of As that are not B approximately, which results in greater proportion-dependent performance. Although we used a purely linguistic task, it is possible that participants engage the Approximate Number System into the verification process. Previous studies (e.g. Moyer & Landauer, 1967; Hinrichs, Yurko & Hu, Psychology, & 1981) show that ANS effects, e.g. distance effect, can be found even in a symbolic number comparison task.

According to the second possible explanation, the proportion effect of most is a result of the pragmatic strengthening. On the one hand, participants represented most as more than half; on the other hand, they had a strong pragmatic preference towards using most for higher
proportions. Before they made a decision, they had to choose between these representations. Future studies need to shed light on disentangling these two competing explanations.

In addition to the proportion effect, we tested if the differences in thresholds in vague quantifiers (*most*, *many*, *few*) will affect the verification process. We found an effect of threshold on reaction times in vague quantifiers, but not in quantifiers with sharp meaning boundaries (*more than half* and *fewer than half*). The lack of threshold effect for *many* was one deviation from this result.

The results presented in this paper clearly suggest that *more than half* and *fewer than half* have unequivocal thresholds. In contrast, *most*, *many* and *few* have varied thresholds. The literature about *many* and *few* (e.g. Partee, 1988) consistently claims that these two quantifiers are highly context dependent and that they can have various interpretations. Our findings suggest that *most* exhibits similar effects. Further experimental studies are needed to explain how these meanings change and are selected in the context. It is possible that the specific context will trigger pragmatic reasoning about *most* and push the thresholds even higher.

Our study fits with an increasing number of findings on individual differences in natural language. Although many studies (e.g. Newstead & Coventry, 2000) investigated how the interpretation of vague quantifiers depends on contextual features like set size (Newstead, Pollard, & Riezebos, 1987; Newstead & Coventry, 2000), size of the stimuli and its position with relation object that creates context (Newstead & Coventry, 2000) or the number of non-target objects (Coventry, Cangelosi, Newstead, & Bugmann, 2010), little attention has been paid to individual differences in meaning representations. We aimed to bridge this gap by finding individual differences in natural language on example of quantifiers.

Our study also has several limitations. Firstly, the task was very abstract. On the one hand, this can be considered as an advantage, because abstract tasks limit pragmatic reasoning and allow us to test semantic differences between quantifiers. On the other hand, it makes quantifiers like *many* and *few* hard to interpret. Secondly, we tested a wide range of proportions, which means that we had only a limited number of trials per proportion and participant. We tried to compensate for this problem by including a large number of participants into our study (Rouder & Haaf, 2018) and excluding the outliers’ responses. Thirdly, in our study all five quantifiers were a within-subject variable. It is therefore possible that estimated thresholds are affected by interaction between quantifiers. For example, some participants might have used the same 50% threshold for *most* and *more than half* to simplify the task (assuming that it is easier to perform the task, when participants have to remember only one threshold instead two). It would be worth testing if the same, or even stronger results, can be observed in a between-subject design. Finally, the logistic regression method, which we used to estimate the thresholds, was not always successful. In future work, we hope to overcome this difficulty by applying more complex methods to estimate the underlying properties of the verification process, such as evidence accumulation modeling (Anders et al, 2015; Ratcliff & McKoon, 2018).

This study contributed to the discussion about differences between *most* and *more than half* by showing that *most* exhibits more sensitivity to individual differences and is proportion-
dependent. In this way, we showed that truth-conditionally equivalent expressions differ in meaning and that *most* is a vague quantifier with various meaning representations. We showed differences between *most* and *more than half* in a novel, purely linguistic task. By using this task, we avoided confounds between semantic meaning of the expression and other cognitive systems and we were able to directly compare *most* with *more than half*. Finally, we presented a new method to investigate individual differences in meaning representations.

**References**


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Appendix A

A.1. Proportion effect on reaction times – random structure

Tests for by-subject random effects: model with only intercept vs. model with random slope for proportion ($\chi^2 (2) = 16.12; p = 0.0003$), model with only intercept vs. model with random slope for response ($\chi^2 (2) = 13.04; p = 0.001$), model with random slope for quantifier had singular fit, model with random slope for proportion vs. model with random slope for proportion and response ($\chi^2 (3) = 3.29; p = 0.35$).

A.2. Individual threshold as predictor of reaction times – random structure
More than half: by-subject random slopes for proportion and response gave singular fit; Most: model with only by-subject intercept vs. model with by-subject random slope for proportion ($\chi^2(2) = 12.71; p = 0.002$), model with only by-subject intercept vs. model with by-subject random slope for response ($\chi^2(2) = 11.40; p = 0.003$); model with both random slopes gave singular fit; Many: model with only by-subject intercept vs. model with by-subject random slope for proportion ($\chi^2(2) = 6.43; p = 0.04$), model with only by-subject intercept vs. model with by-subject random slope for response ($\chi^2(2) = 3.25; p = 0.2$); Few: model with only by-subject intercept vs. model with by-subject random slope for proportion ($\chi^2(2) = 7.81; p = 0.02$), model with only by-subject intercept vs. model with by-subject random slope for response ($\chi^2(2) = 8.86; p = 0.01$); model with two by-subject slopes did not improve fit ($\chi^2(3) = 4.74; p = 0.19$); Fewer than half: model with only by-subject intercept vs. model with by-subject random slope for proportion ($\chi^2(2) = 14.80; p = 0.0006$), model with only by-subject intercept vs. model with by-subject random slope for response ($\chi^2(2) = 18.79; p < 0.0001$); model with two by-subject slopes improved fit ($\chi^2(3) = 7.89; p = 0.04$).

Appendix B

Fewer than half We predicted that the individual thresholds should not influence the reaction times during verification of fewer than half as in case of more than half. We included by subject random intercept and by-subject random slope for percent and response type. By using model comparison, we excluded three-way interaction ($\chi^2(1) = 0.22; p = 0.64$), threshold-response interaction ($\chi^2(1) = 0.15; p = 0.7$), threshold-proportions interaction ($\chi^2(1) = 1.62; p = 0.20$) and proportion-response interaction ($\chi^2(1) = 1.98; p = 0.16$). The final model for fewer than half included only three main effects. The effect of threshold was not significant ($\beta = 15.51; t = 0.62; p = 0.54$).

Many and few Finally we also predicted that the verification time of many and few should be threshold-dependent. We included by-subject random intercept for both quantifiers and by-subject random slope for proportion for many and by-subject random slope for response type for few. For many we did not find a significant main effect of threshold ($\beta = -8.13; t = -0.27; p = 0.78$) but did find a significant threshold-response type interaction ($\beta = -217.42; t = -4.53; p < 0.001$), meaning that the effect of threshold was greater for false responses. We also did not find a significant threshold-proportion interaction ($\beta = -9.46; t = -0.68; p = 0.50$), but did find a significant three-way interaction between proportion, response and threshold ($\beta = -105.31; t = -2.95; p < 0.01$), meaning that for responses false there was a threshold-proportion interaction.

For few, we found a main effect of threshold ($\beta = -237.12; t = -3.86; p < 0.001$), a significant interaction between threshold and response type ($\beta = 197.08; t = 3.55; p < 0.001$), a significant interaction between threshold and proportion ($\beta = -114.40; t = -2.84; p < 0.01$) and a significant three-way interaction between proportion, response and threshold ($\beta = 152.98; t = 3.59; p < 0.001$), meaning that the effect of threshold was stronger for true responses than for false responses and that it influenced the proportion effect stronger for true responses, than false responses.
Abstract. In this paper, we present a formal analysis of the common and yet not well-understood auxiliary jaqaʔ in ?ayʔajuθəm (a.k.a. Comox-Sliammon; Central Salish). Based on original fieldwork, we argue that speakers can use jaqaʔ not only to express wishes or worries, but also to signal the unexpectedness or predictableness of the denoted proposition. To account for this initially perplexing banquet of meanings, we propose — in the spirit of Grosz (2011, 2014) — that jaqaʔ functions as an exclamation operator (EX) that serves to express the speaker’s emotion towards the status of a proposition on a contextually salient scale. As predicted by this approach, the use of jaqaʔ can give rise to optatives, adversatives, polar exclamatives, and congruent exclamatives — a novel type of exclamative we discover in the process. A claim that emerges from the analysis is that Grosz’s EX operator, which is covert in German and English, may be realized overtly in other languages.

Keywords: ?ayʔajuθəm, optatives, adversatives, polar exclamatives, congruent exclamatives.

1. Introduction

This paper provides a first analysis of the elusive auxiliary jaqaʔ in ?ayʔajuθəm (Comox-Sliammon; ISO 639-3: coo), a severely endangered Central Salish language traditionally spoken by four communities — the Tla’amin, Klahoose, Homalco, and K’ómoks — along the Northern Strait of Georgia in British Columbia. According to the most recent survey by the First Peoples’ Cultural Council, approximately 47 L1 speakers remain (FPCC 2018).

As noted by Reisinger (2018), the auxiliary jaqaʔ gives rise to an interesting puzzle for analysis due to the plethora of meanings associated with it. Drawing on original fieldwork, we argue that jaqaʔ is used not only to express a speaker’s wishes (1) or worries (2), but also to signal the unexpectedness (3) or predictableness (4) of the denoted proposition.²

(1) jaqaʔ=čxʷ=ča niš s=ʔukʷ.
JAQAʔ=2SG.SBJ=EPIS be.here NMLZ=today
‘I wish you were here today.’

¹ We are deeply grateful to all the speakers who so patiently and generously have shared their language with us: Elsie Paul, the late Marion Harry, Freddie Louie, Phyllis Dominick, Margaret Vivier, Randy Timothy, Karen Galligos, and Joanne Francis. čəcəhənapəp! We would also like to thank the audiences of ICSNL 54 and SuB 24, Patrick Georg Grosz, Lisa Matthewson, Hotze Rullmann, Henry Davis, as well as the members of the ?ayʔajuθəm Lab and the TAP Lab at UBC for their helpful feedback and ideas. Research for this project was supported through a SSHRC Insight grant (435-2016-1694) awarded to Henry Davis, a Jacobs Research Funds individual grant held by Marianne Huijsmans, and a Jacobs Research Funds group grant held by members of the ?ayʔajuθəm Lab.


(2) Context: Talking about perishable food.

hu=ga qams-at. \textit{jaqa? lāzaw.}
go=IMP put.away-CTR \textit{JAQA? spoil/break.down}
‘Go put it away. It might spoil.’

(3) \textit{jaqa? ?iy qʷə́ təs Hoss.}
\textit{JAQA? CONJ come arrive Hoss}
‘Oh, Hoss arrived!’

(4) \textit{jaqa?=gut ma~matiyq kʷ=tala.}
\textit{JAQA?=DPRT.EXCL IPFV~borrow DET=money}
‘He always comes to borrow money.’

Reisinger (2018) suggests that \textit{jaqa?} may be a circumstantial modal, but leaves a full analysis for future work. Based on more recent fieldwork, we argue that \textit{jaqa?} is not a circumstantial modal, but rather an overt instantiation of the (covert) exclamation operator (EX) proposed in Grosz (2011, 2014). Like the EX operator, \textit{jaqa?} is used to create optatives, adversatives, and polar exclamatives. It also occurs in a type of exclamative that has not been described in previous literature, which expresses that the speaker finds the proposition extremely likely (in contrast to polar exclamatives, which express that the speaker finds the proposition unlikely); we label these congruent exclamatives.

The data presented in this paper come from five speakers of the Tla’amin community, one speaker from Homalco, and two Vancouver-based speakers. To gather these data, we employed a variety of semantic fieldwork methodologies, including direct translation with contextual support and judgment tasks (see Matthewson 2004). We also provide examples volunteered spontaneously during elicitation, and examples available in previous documentation.

The remainder of the paper is organized as follows. Section 2 examines the different interpretations associated with \textit{jaqa?} more closely, while Section 3 briefly introduces Grosz’s (2011, 2014) EX operator. Subsequently, Section 4 illustrates how his analysis can be used to account for the data presented in this paper. Lastly, Section 5 concludes this paper.

2. The Readings

The following subsections will illustrate the different readings evoked by the presence of \textit{jaqa?}. Section 2.1 will explore the association of \textit{jaqa?} with wishes, hopes, and desires, while Section 2.2 is dedicated to cases that express worries and concerns. Section 2.3 focuses on the ‘surprise’ readings, and Section 2.4 describes cases that involve excessive predictability. Three of the four readings are indicated by accompanying particles. However, as will become clear in the following subsections, these particles cannot themselves contribute the different readings (they certainly could not contribute these readings without \textit{jaqa?}), though we will argue in Section 4 that they do play a role in disambiguating the different readings.
2.1. Wishes

Sentences in which *jaqaʔ* combines with the enclitic *ča*, an epistemic modal (see Section 4.1), are used to express wishes, hopes, and desires. These ‘wish’ cases are non-factive, either expressing: (i) a wish that has already been frustrated (i.e., the prejacent \( \phi \) is counterfactual), or (ii) a wish whose realization is uncertain (i.e., \( \phi \) is non-counterfactual). The former involve either past or present temporal orientation (T.O.), as shown in (5) and (6). The latter tend to be future-oriented, as shown in (7). However, the non-counterfactual reading is also compatible with a non-future orientation, namely in cases where the speaker does not know at the time of utterance (UT) whether the denoted proposition is true or not, as exemplified by (8) and (9).

(5) **Context:** Something I wanted was on sale, but I hesitated too long and now it is gone.

\[
\begin{align*}
\text{jaqaʔ}:=\text{ča} & \text{ hiya } \text{ yaq-t-ul.} \\
\text{JAQAʔ:=1SG.SBJ=EPIS} & \text{ right.away buy-CTR-PST} \\
\text{‘I should have bought it right away.’} \\
\end{align*}
\]

[counterfactual: past T.O.]

(6) **Context:** I want to go sailing.

\[
\begin{align*}
\text{jaqaʔ}:=\text{ča}=\text{ʔut pub-<i>ि>m.} \\
\text{JAQAʔ:=EPIS=EXCL} & \text{ blow-MD<STV>} \\
\text{‘I wish it were windy.’} \\
\end{align*}
\]

[counterfactual: present T.O.]

(7) **jaqaʔ:=ča \(?\text{y}\) ʔukʰ kʷəy.**

\[
\begin{align*}
\text{JAQAʔ:=EPIS} & \text{ good day tomorrow} \\
\text{‘I hope it’s sunny tomorrow.’} \\
\end{align*}
\]

[non-counterfactual: future T.O.]

(8) **Context:** One of your friends is out on a hiking trip in the mountains. You hope that he has good weather for his hike.

\[
\begin{align*}
\text{jaqaʔ:=ča } \text{xʷaʔ } \text{ č̓ə ~ č̓l } & \text{ as } \text{ s=čaʔat.} \\
\text{JAQAʔ:=EPIS NEG IPFV ~ rain=3SBJV NMLZ=now} \\
\text{‘I hope it is not raining right now.’} \\
\end{align*}
\]

[non-counterfactual: present T.O.]

(9) **Context:** One of your friends went for a hike in the mountains yesterday. You hope that he had good weather for his hike.

\[
\begin{align*}
\text{jaqaʔ:=ča } \text{xʷaʔ } \text{ č̓l } & \text{ as } \text{ s=]as-ul.} \\
\text{JAQAʔ:=EPIS NEG rain=3SBJV NMLZ=yesterday-PST} \\
\text{‘I hope it didn’t rain yesterday.’} \\
\end{align*}
\]

[non-counterfactual: past T.O.]

2.2. Worries

In addition to wishes, *jaqaʔ* sentences can also be used to express worry or concern. Just like the ‘wish’ cases, this reading is restricted to non-factive propositions. More precisely, we have

---

3 Following Grosz (2011), we use the term *non-factive* to cover all cases where \( \phi \) is not considered true by the speaker. This includes both counterfactual readings (i.e. the speaker knows \( \phi \) to be false) as well as non-counterfactual readings (i.e., the speaker does not know whether \( \phi \) is true or false).

4 Following Condoravdi (2002), we use the term *temporal orientation* to describe the relation between the temporal perspective (which in exclamatives is always the utterance time) and the time of the described event.
found only non-counterfactual worries, and only with a future temporal orientation, as illustrated by the examples in (10) and (11) below.\(^5\)

\[(10)\quad \text{\textit{jaqa\textsuperscript{ʔ}}\textsuperscript{=c} kʷət-əm.}\]
\[\quad \text{JAQA\textsuperscript{ʔ}=1SG.SBJ get.sick-MD}\]
\[\quad \text{‘I might get sick.’} \quad \text{[non-counterfactual: future T.O.]}\]

\[(11)\quad \text{\textit{jaqa\textsuperscript{ʔ}}=c\textsuperscript{xʷ} mamaqʷɬ.}\]
\[\quad \text{JAQA\textsuperscript{ʔ}=2SG.SBJ get.hurt}\]
\[\quad \text{‘You might get hurt.’} \quad \text{[non-counterfactual: future T.O.]}\]

### 2.3. Surprising Events

In addition to wishes and worries, speakers can also use \textit{jaqa\textsuperscript{ʔ}} to mark factive propositions that they consider surprising or unexpected, as illustrated by the examples in (12) and (13). Often, but not always, the particle \textit{ʔiy} — which usually functions as a coordinating conjunction — directly follows \textit{jaqa\textsuperscript{ʔ}} in these cases.

\[(12)\quad \text{Volunteered context: Someone arrived unexpectedly.}\]
\[\quad \text{\textit{jaqa\textsuperscript{ʔ}} (ʔiy) qʷəl̓ tas.}\]
\[\quad \text{JAQA\textsuperscript{ʔ}=CONJ come arrive}\]
\[\quad \text{‘Oh, he arrived!’}\]

\[(13)\quad \text{\textit{jaqa\textsuperscript{ʔ}} ʔiy ʔa~ʔaxʷ s=kʷəjul.}\]
\[\quad \text{JAQA\textsuperscript{ʔ}=CONJ IPFV~snow NMLZ=morning}\]
\[\quad \text{‘Oh, it’s snowing this morning!’}\]
\[\quad \text{Consultant’s comment: “It’s like ... something you didn’t expect.”}\]

### 2.4. Predictable Events

Lastly, \textit{jaqa\textsuperscript{ʔ}} can also combine with the clitic \textit{gut} (see Section 4.4) and a factive proposition, giving rise to a reading where the event is extremely predictable to the speaker, as shown in (14) to (15).

\[(14)\quad \text{Context: Someone you don’t want to see keeps dropping by.}\]
\[\quad \text{\textit{jaqa\textsuperscript{ʔ}}=gut qʷəl̓ tas.}\]
\[\quad \text{JAQA\textsuperscript{ʔ}=DPRT.EXCL come arrive}\]
\[\quad \text{‘Here they are again!’}\]

\(^5\) We surmise that non-counterfactual readings with a past or present T.O. (e.g., ‘They left fairly late this morning. I’m worried they might have missed their ferry.’) should be possible as well. However, when we tried to elicit sentences like this, speakers rejected them and instead offered sentences with a future orientation. Currently, it is not clear whether readings with a past or present T.O. are completely unavailable, or whether speakers simply did not find the provided contexts to be the right contexts to support these readings. We also have not encountered counterfactual worries. It seems likely that these do not exist. After all, while it is possible to \textit{wish} that something had happened, it seems less reasonable conceptually for someone to \textit{worry} that something had happened once it is known that it did not.
In general, speakers tend to judge the prejacent in *jaqa?=gut* constructions as unpleasant or intrusive, as illustrated by the examples above. Yet, it seems this adversity is not an integral part of the construction itself. Given the right context and the right intonation, *jaqa?=gut* is also compatible with propositions that are predictable and pleasant, as highlighted by (16), and propositions considered neutral, as in (17). This suggests that the construction itself only accounts for the predictability component, whereas any emotive flavours arise via implicature.

(16) Context: Someone is always bringing you seafood, which you love.

\[
\text{jaqa?=gut } \text{ta}-\text{iq-aʔam-θ-as } k^*=\text{janx}^*.
\]

\[
\text{JAQA?=DPRT.EXCL IPFV~bring-IND-1SG.OBJ-3ERG DET=fish}
\]

‘He’s always bringing me fish.’

(17) Context: Freddie is always driving people to town.

\[
\text{jaqa?=gut } \text{hu-θu } k^*=\text{tisk}^*\text{at}.
\]

\[
\text{JAQA?=DPRT.EXCL IPFV~go DET=Powell.River}
\]

‘He’s always going to Powell River.’

Researcher: “Can that be just an observation or does it mean that I’m annoyed by it?”

Consultant’s comment: “…it can be just an observation.”

2.5. Summary

The preceding sections have shown that the auxiliary *jaqa?* is an astonishingly versatile marker. Table 1 provides a summary of the different forms and their properties:

<table>
<thead>
<tr>
<th>FORM</th>
<th>WISHES</th>
<th>WORRIES</th>
<th>SURPRISING EVENTS</th>
<th>PREDICTABLE EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>jaqa?=ča</em></td>
<td><em>jaqa?</em></td>
<td><em>jaqa? (ʔiy)</em></td>
<td><em>jaqa?=gut</em></td>
<td></td>
</tr>
<tr>
<td>FUNCTION</td>
<td>The speaker wishes that φ</td>
<td>The speaker worries that φ</td>
<td>The speaker finds φ surprising</td>
<td>The speaker finds φ predictable</td>
</tr>
<tr>
<td>STATUS OF φ</td>
<td>non-factive</td>
<td>non-factive</td>
<td>factive</td>
<td>factive</td>
</tr>
</tbody>
</table>

3. Towards an Analysis

In the spirit of Grosz (2011, 2014), we propose that the different and seemingly un-unifiable readings associated with *jaqa?* can in fact be unified if we treat this auxiliary as an overt exclamation operator that expresses the speaker’s emotion towards the status of a proposition on a contextually salient scale. In the following subsections, we briefly review the main components of Grosz’s proposal.
3.1. Optatives, Adversatives, and Polar Exclamatives

Grosz (2011) focuses on three types of constructions — optatives, adversatives, and polar exclamatives — which resemble each other in that they all express how the speaker feels towards the denoted proposition.

Optatives express the speaker’s wishes, hopes, or desires, without making use of an overt lexical item that means ‘wish’, ‘hope’, or ‘desire’, as illustrated by the examples from English and German in (18) below.

(18) a. If only I had brought an umbrella!
   Paraphrase: ‘I wish I had brought an umbrella.’
   b. Oh, that I had never left you! [T. S. Arthur. (1868). After the Storm.]
   Paraphrase: ‘I wish that I had never left you.’
   c. Wenn ich nur die Zeit zurückdrehen könnte!
   if I only the time turn.back could
   Literally: ‘If only I could turn back time!’
   Paraphrase: ‘I wish I could turn back time.’

Adversatives, on the other hand, convey the speaker’s disapproval, disgust, or dislike — once again, without the presence of any overt lexical items that carry this meaning. While English seems to lack independent adversatives (Grosz 2011:117), such constructions can be found in German, as exemplified by the sentences in (19).

(19) a. Mein Gott! Der Olaf! Wenn ich den schon sehe!
   my God the Olaf if I him already see
   Literally: ‘Oh my God! Olaf! If I already see him!’
   Paraphrase: ‘It makes me sick if I see Olaf.’ [Scholz 1991:48; Grosz 2011:62]
   b. Dass die aber auch immer Vanilleeis mitbringt!
   that she but also always vanilla.ice.cream brings
   Literally: ‘That she always brings vanilla ice cream!’
   Paraphrase: ‘I find it disappointing that she always brings vanilla ice cream.’
   [Grosz 2011:236]

Lastly, polar exclamatives express the speaker’s surprise, shock, or amazement at a fact. Just like the optative and adversative constructions, these utterances do so without containing lexical items that mean ‘surprise’, ‘shock’, or ‘amazement’, as highlighted by the examples in (20).

(20) a. That you could ever marry such a man!
   Paraphrase: ‘I did not expect that you could ever marry such a man.’ [Quirk et al. 1985:841; Grosz 2011:39]
   b. Dass die dort gewohnt haben!
   that they there lived have
   Literally: ‘That they lived there!’
   Paraphrase: ‘It amazes me that they lived there.’ [Rosengren 1992:278; Grosz 2011:40]
3.2. The EX Operator

Grosz (2011) claims that all three of these constructions contain a covert exclamation operator, which he labels EX. This operator serves to express the speaker’s emotion or evaluative attitude \( \varepsilon \) towards the fact that the denoted proposition \( \varphi \) exceeds a salient threshold on a contextually provided scale \( S \). As illustrated by the overview in (21), every construction relies on a different scale. For instance, in the case of optatives, the denoted proposition is measured against a scale of speaker-preference.

(21) Constructions and their respective scales:

<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
<th>EMOTION</th>
<th>SALIENT SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. optatives</td>
<td>wishes, hopes, desires</td>
<td>speaker-preference</td>
</tr>
<tr>
<td>b. adversatives</td>
<td>disapproval, dislike, disgust</td>
<td>speaker-dispreference</td>
</tr>
<tr>
<td>c. polar exclamatives</td>
<td>surprise, shock, amazement</td>
<td>speaker-unlikelihood</td>
</tr>
</tbody>
</table>

In addition, the EX operator is also expressive (Grosz 2011:87). By this, Grosz means that EX combines with a proposition of type \( \langle s, t \rangle \) and maps it onto felicity conditions which capture how the speaker feels towards the denoted proposition. Thus, the denotation of \( EX(S)(\varphi) \) yields a semantics that is not truth- but rather felicity-conditional, leading to the lexical entry in (22).\(^6\)

(22) For any scale \( S \) and proposition \( \varphi \), interpreted in relation to a context \( c \) and assignment function \( g \), an utterance \( EX(S)(\varphi) \) is felicitous iff \( \forall \psi[ \text{THRESHOLD}(c) >_S \psi \rightarrow \varphi >_S \psi] \).

“EX expresses an emotion that captures the fact that \( \varphi \) is higher on a (speaker-related) scale \( S \) than all contextually relevant alternatives \( \psi \) below a contextual threshold.”

where \( \text{THRESHOLD}(c) \) is a function from a context into a set of worlds / a proposition that counts as high with respect to a relevant scale \( S \).

[Grosz 2011:91]

To sum up, an utterance of the form \( EX(S)(\varphi) \) has the following properties: (i) the speaker has an emotion or evaluative attitude \( \varepsilon \) towards the proposition \( \varphi \) at UT, (ii) the speaker wants not just to describe, but rather to express \( \varepsilon \), and (iii) \( \varepsilon \) is based on a scale (e.g., a scale of speaker-preference in the case of optatives).

3.3. The Role of Particles

In addition to this EX operator, we also need something to help us identify the appropriate scale against which the denoted proposition will be measured. For instance, the German utterance in (23) can be interpreted as a polar exclamative, an optative, or an adversative — depending on the context.\(^7\)

\(^6\) Following this argument, Grosz would consider the sentence in (i), which does not involve the EX operator, as truth conditional. The optative construction in (ii), on the other hand, would be regarded as felicity-conditional within Grosz’s analysis due to the presence of the EX operator.

(i) [I wish I had gone to Galway.] \( \Rightarrow \) describes my desire
(ii) [EX [If only I had gone to Galway.]] \( \Rightarrow \) expresses my desire

\(^7\) A reviewer notes that the optative reading in (23) is not available to them. While this judgment does not match the intuitions of the first author, we acknowledge that the optative reading is indeed only marginally conceivable without further context. For a parallel example with these readings, see Grosz (2011:146).
Dass die Saoirse gegangen ist!
that the Saoirse left is
Literally: ‘That Saoirse left!’
Most plausible paraphrase: ‘I am surprised [that Saoirse left].’
Conceivable paraphrase: ‘I hope [that Saoirse left].’
Conceivable paraphrase: ‘I am disappointed [that Saoirse left].’

Grosz (2011:146) highlights that these three readings can be disambiguated by adding certain cues. For instance, adding the particle nur (‘only’) to the sentence above will make the optative reading salient, as shown in (24). Adding the particle auch (‘also’), on the other hand, will foreground the adversative interpretation, as shown in (25).8 This process of disambiguation, which essentially represents the elimination of competing readings, is driven by incompatibilities between certain particles and certain utterance types.9

(24) Oh, dass die Saoirse nur gegangen ist!
oh that the Saoirse only left is
‘I hope that Saoirse left.’

(25) Dass die Saoirse auch gegangen ist!
that the Saoirse also left is
‘I am disappointed that Saoirse left.’

Particles like these can be found not only in German (e.g., nur, doch, aber, schon, auch, wenigstens…), but also in English, as illustrated by the optative constructions in (26) below.

(26) a. If I’d only listened to my parents!
    b. If I could just make them understand my point of view!
    c. If I could but explain! [Quirk et al. 1985:842; Grosz 2011:13]

In Grosz’s (2011) proposal, these prototypical particles are truth-conditionally vacuous and do not convey optativity themselves. Instead, they act as presupposition triggers that offer additional information with respect to the denoted proposition. Primarily, this additional information modulates the expressed emotion. For instance, only presupposes that φ is low on the contextually provided scale, thus giving rise to the notion of ‘moderation’. In the case of optatives, the addition of the particle only consequently conveys that φ ‘is really not much to ask for’ (Grosz 2011:268).

The use of such particles is governed by a constraint that Grosz (2014:93) calls Utilize Cues:

(27) Utilize Cues:
    a. If a marked use of an ambiguous utterance can be made more salient by adding certain elements (e.g., particles, interjections, intonational tunes) to this utterance,

8 A reviewer points out that the addition of auch in (25) does not suffice to clearly disambiguate the adversative from the polar exclamative reading and suggests that prosody may be a better disambiguator. While we believe that the presence of auch does foreground the adversative reading (at least to some extent), we agree that this effect can be overturned by certain intonational tunes.

9 For a detailed discussion of this phenomenon, see Grosz (2011:386–387).
the addition of one (or more than one) such element is obligatory. Such elements qualify as cues for the respective utterance use.

b. The requirement in (27a) can be obviated if the intended utterance use is independently prominent in the utterance context.

Essentially, this constraint posits that speakers must make use of available cues (e.g., particles, interjections) whenever the intended reading of a given utterance is marked and not sufficiently supported by the context — as the hearer will otherwise revert to the most unmarked interpretation in the given context. Often, this leads to the impression that particles are quasi-obligatory (Grosz 2011:387–389; 2014:95).10

4. jaqa? as an overt EX operator

With the theoretical background in place, this section shows how Grosz’s (2011, 2014) analysis can be used to account for the jaqa? data which we have found in ʔayʔaǰuθəm. Essentially, we argue — in the spirit of Grosz — that jaqa? is an overt EX operator which expresses that φ is higher on a speaker-related scale S than all contextually relevant alternatives ψ below a contextually determined threshold.11 In this way, jaqa? (S) (φ) maps the descriptive content φ to expressive content, communicating an emotion or evaluative attitude toward φ.

(28) \[
\text{jaqa}? \] (S) (φ) is felicitous iff \( \phi > _S \text{THRESHOLD} (c) \)

where \( \phi > _S \text{THRESHOLD}(c) \) abbreviates \( \forall \psi[\text{THRESHOLD} (c) > _S \psi \rightarrow \phi > _S \psi] \)

and \( \text{THRESHOLD} \) is a function from a context into a set of worlds/a proposition that counts as high with respect to a relevant scale S.

[adapted from Grosz 2011:91]

For the ‘wish’ cases presented in Section 2.1, the denoted proposition is measured against a scale of speaker-preference, consequently resulting in an optative reading. Conversely, the ‘worry’ cases from Section 2.2 involve a scale of speaker-dispreference, which evokes an adversative reading. The ‘surprise’ cases described in Section 2.3 involve a scale of speaker-unlikelihood and, therefore, can be classified as polar exclamatives.

At this point, all three readings that Grosz (2011) describes have also been attested in ʔayʔaǰuθəm. In addition, we propose the existence of one more construction, which we will call congruent exclamatives. These involve a scale of speaker-likelihood and, consequently, form the counterpoint to polar exclamatives. More specifically, we propose that, while polar exclamatives highlight the contrast between what is the case and what is expected (Grosz 2011:383), congruent exclamatives emphasize the congruence between what is the case and what is expected (Grosz 2011:383), congruent exclamatives emphasize the congruence between what is the case and

10 Many details of this constraint are yet to be worked out, such as the relative weight of different kinds of cues (e.g., particles vs. intonation). We leave this for future research.

11 According to Grosz (2011), English optative constructions consist of a covert EX operator which scopes over an overt complementizer, such as if or that. We argue that jaqa? is not a complementizer based on the fact that it never introduces a subordinate clause. Instead, we propose that jaqa? acts as an overt EX operator which does not require the presence of a complementizer. While this approach accounts for the cases discussed in this paper, there are certain apparent optative constructions in which jaqa? does not appear, as in (i). It may be necessary to posit a covert EX operator to handle these cases.

(i) xʷaʔ=an=χʷuʔt
kʷat-m=an.
NEG=1SG.SBJV=CLT sick-MD=1SG.SBJV
‘I hope I don’t get sick.’ [Watanabe 2016:322]
what is expected. In other words, the facts in the real world match our expectations, thus allowing the speaker to express that they consider the denoted proposition to be highly predictable. By introducing this new category, we fill a notable gap in Grosz’s (2011) paradigm of exclamative scales. 

The four different readings that we have outlined above can be disambiguated via certain cues (e.g., enclitics and particles) — just as predicted by Grosz’s (2011, 2014) analysis. The disambiguating function of the cues is illustrated in the examples (29) to (32), where the same predicate (ɬaχaw ‘to spoil / to break down’) in combination with jaqaʔ receives different readings depending on which enclitic or particle appears in the construction.

(29) **Context:** Talking about a car.
jaqaʔ=ča ɬaχaw.
JAQAʔ=EPIS spoil/break.down
‘[I hope] that it breaks down!’
*Consultant’s comment:* ‘... because you want a new one.’

(30) hu=ga qams-at. jaqaʔ ɬaχaw.
go=IMP put.away-CTR JAQAʔ spoil/break.down
‘Go put it away. [I’m worried] that it will spoil!’

(31) jaqaʔ (ʔi)y ɬaχaw.
JAQAʔ CONJ spoil/break.down
‘Oh, [I’m surprised] that it spoiled!’

(32) jaqaʔ=�tut ɬaχ~ɬaχaw šo=?atnupil-s.
JAQAʔ=DPRT.EXCL PL~spoil/break.down DET=car-3POSS
‘[It’s predictable] that her car is breaking down again!’

Table 2 provides an overview of the different constructions, the scales they are based on, and the cues that help foreground the intended reading.

---

12 It seems plausible that congruent exclamatives can also be found in other languages. For instance, the German example in (19b) — repeated below as (i) — could also be attributed to this category. Grosz (2011:236) argues that this utterance expresses disapproval and, consequently, should be classified as an adversative. In contrast, we propose that this utterance is, at its core, a congruent exclamative which highlights the predictability of the denoted proposition, and that the disapproval interpretation arises independently via certain intonational tunes. This reclassification is motivated by the fact that, in other contexts, the same construction is also compatible with notions like appreciation or admiration, as exemplified in (ii). Thus, the common denominator that remains is the high predictability of ϕ.

(i) Dass die aber auch immer Vanilleeis mitbringt!
that she but also always vanilla.ice.cream brings
Literally: ‘That she always brings vanilla ice cream!’
Grosz’ original paraphrase: ‘[It’s disappointing] that she always brings vanilla ice cream.’
Updated paraphrase: ‘[It’s predictable] that she always brings vanilla ice cream.’

(ii) **Context:** You appreciate that your friend sent you a card for your birthday, as she does every year.
Dass die aber auch immer an meinen Geburtstag denkt!
that she but also always on my birthday thinks
‘[It’s predictable] that she always remembers my birthday.’
Table 2: An overview of the different *jaqaʔ* constructions

<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
<th>WISHES</th>
<th>WORRIES</th>
<th>SURPRISING EVENTS</th>
<th>PREDICTABLE EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optatives</td>
<td></td>
<td></td>
<td>Polar Exclamatives</td>
<td>Congruent Exclamatives</td>
</tr>
<tr>
<td>Adversatives</td>
<td></td>
<td></td>
<td>Speaker-Unlikelihood</td>
<td>Speaker-Likelihood</td>
</tr>
<tr>
<td>Speaker-Preference</td>
<td></td>
<td>Speaker-Dispreference</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One positive side effect of the present analysis is that it explains why all *jaqaʔ* constructions appear to be speaker-oriented. In the optative utterance in (33), for instance, it is the speaker — not the second person subject — that holds the wish, thus giving rise to a bouletic interpretation. Similarly, it is the speaker — not the bear — that expresses disapproval towards the denoted proposition in the adversative case in (34). The polar exclamative in (35) is speaker-oriented as well, as the subject of the clause (i.e., the meat) is evidently incapable of feeling surprise. Likewise, ‘the rain’ in the congruent exclamative in (36) cannot judge the predictability of the proposition — instead, it is the speaker who makes this judgment.

(33) *jaqaʔ*=čxʷ=č̓a=qəɬ qʷə l̓qamin-ul.  
JAQAʔ=2SG.SBJ=EPIS=IRR come accompany-PST  
‘You should have come along.’ [optative]

(34) *jaqaʔ* qʷəł makʷ-čt=čxʷ!  
Context: A bear is coming and you think that it might go into your smokehouse and eat your fish.  
qʷəł ta=mičał.  i̱kʷən-i-t=čxʷ!  
IPFV~come DET=bear see-STV=CTR=2SG.SBJ JAQAʔ=come eat-CTR-3ERG  
ta=ms=janxʷ.  
DET=1PL.POSS=fish  
‘A bear is coming. Look! It might eat our fish!’ [adversative]

(35) *jaqaʔ* ?iy łaʔaw.  
JAQAʔ CONJ spoil/break.down  
‘Oh, it spoiled!’ [polar exclamative]

(36) *jaqaʔ*=gut č̓ə-čł.  
JAQAʔ=DPRT.EXCL IPFV~rain  
‘It’s always raining.’ [congruent exclamative]

Not only is *jaqaʔ* generally speaker-oriented, it cannot express the attitude of another party toward the proposition even where the context sets this up. For instance, (37) is only felicitous

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13 An exception to this is the use of exclamatives in narratives, where *jaqaʔ* constructions may sometimes express the attitude of the protagonist. Although we have not investigated these cases in detail, it seems plausible that they involve some kind of perspective shifting commonly associated with free indirect discourse (see Eckhardt 2014).
under a speaker-oriented reading, and (38), where there is no salient speaker-oriented reading available, was strongly dispreferred.

(37) Context: Someone really wants to stay here, but you don’t want that person around.
    # jaqaʔ=ča niš taʔa.
    JAQAʔ=EPIS be.here DEM
    ‘He wishes to stay here.’ (Ok for ‘I wish that he would stay here.’)

(38) Context: I see that you are really surprised by my arrival.
    # jaqaʔ=qʷəl̓təs!
    JAQAʔ=1SG.SBJ come arrive
    ‘[You find it surprising] that I’ve arrived.’

As discussed earlier, optatives and adversatives are non-factive, whereas polar exclamatives and congruent exclamatives are factive. This aligns with Grosz’s (2011:454) observation that (dis)preference scales are associated with non-factive mood, whereas (un)likelihood scales are associated with factive mood. In Grosz (2011), the semantic mood — related to, but distinct from morphological mood — encodes the distinction between factive, non-counterfactual, and counterfactual propositions. Factive and counterfactual moods involve presuppositions that the speaker believes φ to be true or false, respectively. Non-counterfactual mood does not introduce any presupposition regarding the truth or falsity of φ.

(39) Semantic Mood (Grosz 2011:78–79)
    a. \[\text{Mood}_{\text{FACT}} = \lambda w : \text{Dox}_{\text{Speaker}}(w) \subseteq \varphi \cdot \varphi(w)\] [factive]
       “The speaker presupposes φ to be true.”
    b. \[\text{Mood}_{\text{CF}} = \lambda w : \varphi \cap \text{Dox}_{\text{Speaker}}(w) = \emptyset \cdot \varphi(w)\] [counterfactual]
       “The speaker presupposes φ to be false.”
    c. \[\text{Mood}_{\text{NCF}} = \lambda w : \varphi(w)\] [non-counterfactual]
       (Mood_{NCF} does not trigger any presupposition w.r.t. the truth or falsity of φ)

In the constructions with jaqaʔ in ʔayʔa Juʔam, propositions interpreted as factive, counterfactual, and non-counterfactual have no overt mood marking. We propose that the semantic mood is determined by a combination of context and the contribution of clitics, as will be explored in more detail in the following subsections.

4.1. The Optatives

As already indicated, the ‘wish’ readings presented in Section 2.1 can be classified as optative constructions. As such, they are only felicitous if the denoted proposition lies above a salient threshold on the scale of speaker-preference, as is the case for ‘it breaks down’ in example (40). To eliminate competing readings, the clitic ˈca serves as optativity cue.

(40) jaqaʔ=ˈca layaw.
    JAQAʔ=EPIS spoil/break.down
    ‘[I hope] that it breaks down!’

Consultant’s comment: “... because you want a new one.”
To get an idea of the exact contribution of this optativity cue, we have to take a look at its canonical use. As illustrated by the declarative utterance in (41), č̓a usually acts as an inferential modal (Watanabe 2003; Reisinger 2018). As such, it can only be used felicitously when the speaker does not have direct evidence for the denoted proposition (42a). If this condition is met, č̓a makes the strong modal claim that φ is true in all worlds within the speaker’s epistemic modal base ∩f(w), as sketched in (42b).

(41) ʔamut=č̓a Freddie. ʔ=̓it t̓o=nik̓=ayu-s.  at.home=EPIS Freddie get.lit=STV DET=light-3POSS  ‘Freddie must be at home. His lights are on.’

(42) The lexical semantics of the inferential modal č̓a:
   a. presupposition:  
      \[\text{⟦č̓a⟧}^c,w(f(φ)) \text{ is defined iff } f \text{ is an epistemic modal base and } φ \text{ is a proposition, and the speaker does not have direct evidence for } φ \text{ in } c.\]
   b. truth-conditional content:
      When defined, \[\text{⟦č̓a⟧}^c,w = λf(φ₁)(s₁,t₁) \cdot λφ(φ₂)(s₂,t₂) \cdot \forall w' [ w' ∈ ∩f(w) \rightarrow φ(w') = 1 ]\]

Due to the presupposition in (42a), č̓a — like other epistemic modals — is incompatible with propositions whose truth value the speaker already knows.¹⁴ We propose that this generalization also applies in the jaqaʔ cases. More precisely, since č̓a can only occur in non-factive contexts, its presence eliminates both the polar exclamative and the congruent exclamative reading, forcing the selection of a non-factive (non-counterfactual or counterfactual) mood. Additional contextual cues, such as intonation, will further eliminate the competing adversative interpretation, thus foregrounding the intended optative reading.¹⁵

While the presuppositional content of epistemic č̓a also applies in the non-canonical jaqaʔ cases, its truth-conditional content — as formalized in (42b) — does not. Thus, in the spirit of Grosz (2011, 2014), we argue that this particle is truth-conditionally vacuous and represents a “weaker” version of its canonical usage.¹⁶

At this point, we have all the core ingredients needed to account for the optative construction in (40) above. Their semantic contributions are summarized in (43) below.

(43) a. felicity conditions:
   \[\text{⟦jaqaʔ⟧}^c,w (\text{Speaker-Preference}) (\text{it breaks down}) \text{ is felicitous iff } \forall ψ [ \text{THRESHOLD (c)} > \text{Speaker-Preferences } ψ \rightarrow \text{it breaks down } > \text{Speaker-Preferences } ψ]\]
   “The speaker expresses the emotion that [it breaks down] is above a salient threshold on the speaker’s preference scale.”
   b. mood information:
      Mood_NCF does not trigger any presupposition with respect to the truth or falsity of [it breaks down].

¹⁴ What counts as direct evidence is likely context-sensitive (see von Fintel & Gillies 2010).
¹⁵ As noted by Grosz (p.c.), this predicts that č̓a should be able to also occur in the adversative cases, given the right intonation. However, this is not the case, as č̓a fully disambiguates the reading in favor of optativity. At present we have no satisfying explanation for this fact.
¹⁶ For a more detailed discussion of this phenomenon, see Grosz’s (2011:277) discussion of English only.
c. particle contribution:

“The particle č̓a triggers the presupposition that the speaker does not have direct evidence for [it breaks down].”

Before closing this section, we would like to note that counterfactual optatives often — but not always — include the irrealis marker qəɬ, as shown in (44). In its canonical use, illustrated by the example in (45), this clitic marks counterfactuality. Since optatives are the only jaqaʔ utterances that are compatible with counterfactuality, it seems reasonable to treat the presence of qəɬ in (44) as an additional optativity cue. While this provides further evidence for Grosz’s (2011:387) hypothesis that cues can be accumulated for disambiguation purposes, a detailed semantic analysis of qəɬ has to await another occasion.

(44) jaqaʔ=čxʷ=č̓a=qəɬ niš-ul.
    JAQAʔ=2SG.SBJ=EPIS=IRR be.here-PST
    ‘You should have been here.’

(45) ?ut=č=qəɬ xʷaʔ kʷən-axʷ=an, qəɬ q̓ətxʷ tə=ms=ʔayaʔ.
    IF=1SG.SBJ=IRR NEG see-NCTR=1SG.SBJ V IRR burn DET=1PL.POSS=house
    ‘If I hadn’t seen it, our house would have burnt.’

4.2. The Adversatives

The ‘worry’ readings outlined in Section 2.2 can be classified as adversative constructions. Thus, an utterance like (46) will only be felicitous if the denoted proposition (i.e., ‘it spoils’) exceeds the salient threshold on the scale of speaker-dispreference.

(46) hu=ga q̓oms-at. jaqaʔ laʔaw.
    go=IMP put.away-CTR JAQAʔ spoil/break.down
    ‘(Go put it away.) [I’m worried] that it spoils!’

In terms of mood, adversatives always appear with a non-counterfactual mood. This may be due to the fact that worries inherently deal with propositions that are not settled as true or false at the time of utterance.

However, the most striking peculiarity of the adversative constructions in ?ayʔajʊʔəm is the apparent lack of any overt disambiguators. In particular, the adversative would seem to be ambiguous with the polar exclamative, given the frequent elision of the particle ?iy in the latter. While this is true on a surface level, our consultants have pointed to an intonational difference in the way jaqaʔ itself is pronounced (vowel lengthening and possibly raised pitch for the polar exclamatives) that disambiguates between these two readings. We therefore speculate that intonation and contextual biases ensure that the hearer can identify the intended interpretation.

The ingredients that give rise to the adversative jaqaʔ utterances are summarized in (47).

(47) a. felicity conditions:
    [ jaqaʔ ]c,w (SSpeaker-Dispreference) (it spoils) is felicitous iff
∀ψ[\text{THRESHOLD (c) > Speaker-Dispreferences } \psi \rightarrow \text{it spoils > Speaker-Dispreferences } \psi]\]

“The speaker expresses the emotion that [it spoils] is above a salient threshold on the speaker’s dispreference scale.”

b. \textit{mood information:}

\text{Mood}_{\text{DEF}} \text{ does not trigger any presupposition with respect to the truth or falsity of [it spoils].}

c. \textit{particle contribution:}

\text{none}

4.3. The Polar Exclamatives

The ‘surprise’ readings that we introduced in Section 2.3 can be classified as polar exclamatives. Consequently, the utterance in (48) will only meet the felicity conditions if the proposition (i.e., ‘it spoiled’) exceeds the salient threshold on the scale of speaker-unlikelihood. Since speakers can only express surprise towards a proposition that is true, the semantic mood of polar exclamatives is always factive.

(48) \textit{jaqaʔ ʔiy ɬa}\text{aw.}

\text{JAQAʔ CONJ spoil/break.down}

‘Oh, [I’m surprised] that it spoiled!’

As already indicated, speakers can add the particle \(ʔy\) — canonically translated as ‘and’ or ‘but’ — to a \textit{jaqaʔ} utterance to foreground the polar exclamative reading. The link between conjunction-like elements and the concept of ‘surprise’ is not completely novel from a cross-linguistic perspective. For instance, the literature on modal particles in German has repeatedly called attention to the fact that \textit{aber} ‘but’ can not only be used as an adversative conjunction, but also as a modal particle that suggests counter-expectation (see Hinterwimmer & Ebert 2018, among many others), as in (49):

(49) \textit{Können Sie aber tanzen!}

can you but dance

‘I’m surprised how well you can dance.’ \quad \text{[Thurmair 1989:191]}

Loosely following Hinterwimmer and Ebert’s (2018) analysis of the German particle \textit{aber} ‘but’, we propose the following lexical semantics for \(ʔy\):\(^{17}\)

(50) a. \textit{presupposition:}

\[\llbracket \ ʔy \rrbracket^{c,w}_{\psi}(\phi) \text{ is defined iff there is a salient proposition } \psi \text{ entailing } \neg\phi \text{ in } c.\]

b. \textit{truth-conditional content:}

When defined, \[\llbracket \ ʔy \rrbracket^{c,w}(\phi) = \phi\]

Thus, polar exclamative \textit{jaqaʔ} constructions are the result of the following ingredients:

\(^{17}\) As noted above, \(ʔy\) canonically serves either as an additive conjunction (‘and’) or a contrastive conjunction (‘but’). We assume that only the contrastive — but not the additive — realization carries the presupposition presented in (50a), suggesting the existence of two separate lexical entries for the conjunction \(ʔy\).
(51) a. *felicity conditions*: 

\[
\left[ \text{\textit{jaqa}} \right]_{c.w}^{c.w} (\text{Speaker-Unlikelihood}) \ (\textit{it spoiled}) \ \text{is felicitous iff}
\forall \psi [\text{THRESHOLD} (c) > \text{Speaker-Unlikelihood} \ \psi \rightarrow \text{it spoiled} > \text{Speaker-Unlikelihood} \ \psi]
\]

“The speaker expresses the emotion that [it spoiled] is above a salient threshold on the speaker’s unlikelihood scale.”

b. *mood information*: 

\(\text{Mood}_{\text{FACT}}\) triggers the presupposition that

\[\text{Dox}_{\text{Speaker}} \subseteq \{w: \text{it spoiled in } w\}\]

“The speaker presupposes \(\varphi\) to be true.”

c. *particle contribution*: 

“The particle \(\text{ʔiy}\) triggers the presupposition that there is a salient proposition \(\psi\) entailing \(\neg [\text{it spoiled}]\) in the context.”

4.4. The Congruent Exclamatives

Lastly, we argue the utterances presented in Section 2.4 exceed a contextually salient threshold on a scale of speaker-likelihood, consequently expressing that the denoted proposition is more than predictable, as in (52). Just like the polar exclamatives, these congruent exclamatives require a factive mood.

(52) \(\text{jaqa}\equiv\text{gut}\)  \(\text{ʔiy} \sim \text{ʔatnupil-s}.\)

\(\text{JAQA}\equiv\text{DPRT.EXCL} \ \text{PL~spoil/break.down} \ \text{DET~car-3POSS}\)

‘[It’s predictable] that her car is breaking down!’

To foreground this interpretation, speakers employ the particle \(\text{gut}\), which seems to be a contraction of \(\text{ga}\) and \(\text{ʔut}\). The clitic \(\text{ʔut}\) is a scalar exclusive that is sometimes used in propositions picking out the top of a scale of alternatives (Huijsmans 2019), as illustrated by example (53) — a use that the English scalar exclusive *just* has as well when it functions as an extreme degree modifier (Morzycki 2012; Beltrama 2016), as exemplified in (54).

(53) \(\text{Context: A character in a storyboard is being described as very industrious.}\)

\(\text{paya}\equiv\text{kʷa} = \text{ʔut}\)  \(x^w i-x^w ip\text{-umix}^w.\)

\(\text{always}=\text{quot}=\text{excl} \ \text{ipfv}=\text{sweep-ground}\)

‘He was always sweeping.’  [Huijsmans 2019]

(54) Your shoes are *just* huge.  [Beltrama 2016:80]

Beltrama (2016) proposes that extreme degree modifiers (EDMs) are metalinguistic intensifiers that signal that the proposition is stronger than all alternative expressions available to the speaker in the context. We can adopt a slightly modified version of his analysis to model the contribution of \(\text{ʔut}\). As an EDM, \(\text{ʔut}\) presupposes that there are alternatives to \(\varphi\) and that all alternatives \(\psi\) are lower on the scale than \(\varphi\). In the congruent exclamatives, we propose that the contextually given alternatives are the same speaker-likelihood scalar alternatives that are quantified over by the \(EX\) operator.\(^{18}\) The clitic \(\text{ʔut}\) can therefore indicate that \(\varphi\) is the highest

\(^{18}\) We propose that both operators involve the same set of scalar alternatives because this scale is particularly salient in the context.
proposition out of the alternatives on the speaker’s likelihood scale in a given context. Example (55) presents the denotation for this element.19

(55) a. presupposition:
\[
\llbracket ?u \rrbracket^{c,w}(\varphi) \text{ is defined iff } \exists \psi \left[ \psi \in \llbracket \varphi \rrbracket^{c}_{\text{ALT}} \right] \wedge \forall \psi \left[ \psi \in \llbracket \varphi \rrbracket^{c}_{\text{ALT}} \rightarrow \left[ \varphi >_{c} \psi \right] \right]
\]
where \( \varphi \) refers to the prejacent and \( \llbracket \varphi \rrbracket^{c}_{\text{ALT}} \) denotes the set of alternatives to \( \varphi \) in \( c \)

b. truth-conditional content:
When defined, \( \llbracket ?u \rrbracket^{c,w}(\varphi) = \varphi \)

The clitic \( ga \) is less well understood but seems to be a discourse particle, indicating that \( \varphi \) is likely given some \( \psi \) in the context, as shown in (56).

(56) čə-čɬ-ul=iyt s=kʷiţul tʰ=hu-sxʷ-ul ʔaʔal=taŋ. 1SG.POSS=go-CAUS-PST umbrella
IPFV~rain-PST=PRT NMLZ=morning go work-STV-MD-PST be=DPRT
‘It was raining when I went to work this morning. That’s why I brought an umbrella.’

We therefore propose that \( ga \) introduces the presupposition presented in (57) but leaves the propositional content unaffected.

(57) a. presupposition:
\[
\llbracket ga \rrbracket^{c,w}(\varphi) \text{ is defined iff } \exists \psi \text{ in } c, \text{ such that } \psi(w) = 1 \text{ and } \varphi \text{ is likely given } \psi 
\]

b. truth-conditional content:
When defined, \( \llbracket ga \rrbracket^{c,w}(\varphi) = \varphi \)

We propose that this presupposition of likeliness given the context disambiguates in favor of a speaker-likelihood scale for the alternatives quantified over by \( jaqa? \) and the EDM \( ?u \). The clitic \( ?u \) then further contributes that \( \varphi \) is at the top of the likelihood scale, so that these congruent exclamatives involve events that are extremely predictable.

(58) a. felicity conditions:
\[
\llbracket jaqa? \rrbracket^{c,w}(S_{\text{Speaker-Likelihood}} (\text{it broke down}) \text{ is felicitous iff } \\
\forall \psi[\text{THRESHOLD } (c) > S_{\text{Speaker-Likelihood}} (\psi) \rightarrow \text{it broke down} > S_{\text{Speaker-Likelihood}} (\psi)]
\]
“The speaker expresses the emotion that [it broke down] is above a salient threshold on the speaker’s likelihood scale.”

b. mood information:
Mood_{\text{FACT}} triggers the presupposition that
\( \text{DOX}_{\text{Speaker}} \subseteq \{ w : \text{it broke down in } w \} \)
“The speaker presupposes \( \varphi \) to be true.”

c. particle contribution \( ga \):
“\( ga \) triggers the presupposition that [it broke down] is likely given some \( \psi \) in the context.”

d. particle contribution \( ?u \):

19 According to Beltrama (2016), EDMs map truth-conditional to expressive content, so that this content is composed on a separate tier, while the truth-conditional content remains unaltered.
“The particle ʔut indicates that [it broke down] is the highest proposition on the scale of all contextually given scalar alternatives.”

5. Conclusion

In this paper, we have argued that ʔajaʔ is an overt realization of Grosz’s (2011, 2014) EX operator, which allows speakers to construct optatives, adversatives, and polar exclamatives. In addition, we introduced a new type of exclamative, namely congruent exclamatives, that expresses the speaker’s emotion or evaluative attitude towards the predictableness of the denoted proposition, thus filling a striking gap in the original scale system as outlined by Grosz (2011). Lastly, our analysis provides further evidence for the existence of Grosz’s EX operator cross-linguistically, highlighting that work on understudied languages is important to the development of our theoretical understanding of optative constructions.

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Eliminating EARLIEST: a general semantics for before and after
Jessica RETT — University of California, Los Angeles

Abstract. Despite recent proposals, there are still empirical gaps in the study of the semantics of temporal relations, including the precise truth conditions of before and after constructions. Theoretically, there is disagreement about whether the constructions involve aspectual coercion operators, like EARLIEST, that privilege certain bounds over others (Beaver and Condoravdi, 2003; Condoravdi, 2010); or whether non-veridical interpretations of before constructions are the result of intensionality or semantic underspecification (Krifka, 2010b). In this paper, I focus on the truth conditions of before and after constructions as they are conditioned by different aspectual classes across languages, and propose a reformulation of the semantics of before and after that characterizes them as antonymic in a particular way inspired by the treatment of comparatives in the degree-semantic literature. I argue that the result is a more empirically comprehensive and explanatory theory of relations between ordered plurals in general.

Keywords: temporal relations, aspect, maximality, interval semantics, degree semantics.

1. Introduction

It has been clear since Elizabeth Anscombe’s (1964) seminal paper that before and after constructions differ from one another in asymmetric ways. Her observations about the differences between the two regarded their (anti-)transitivity, (anti-)symmetry, and potential for ‘alternative verifications’; in subsequent discussion, linguists tend to cast these same differences in terms of NPI-licensing, veridicality, and ambiguity (Heinämäki, 1974; Ogihara, 1995). And while Anscombe concluded that these differences indicated before and after are not lexical converses, the subsequent consensus has been to treat them as lexical converses and to explain the asymmetric differences in before and after constructions by appealing to sentence-level phenomena, like aspectual coercion (Heinämäki, 1974); metaphysical differences in precedence/subsequence relations (Beaver and Condoravdi, 2003; Condoravdi, 2010); or broad pragmatic effects (Krifka, 2010b).

A series of recent semantic treatments of before and after have focused principally on accounting for intuitions that the internal arguments of after (but not necessarily for before) constructions are entailed, and that NPIs are licensed in the internal arguments of all before constructions (Beaver and Condoravdi, 2003; Condoravdi, 2010; Krifka, 2010b), but only a restricted subset of after constructions. I argue that these analyses capture these veridicality and NPI facts at the expense of properly characterizing their truth conditions.

In what follows, I present a more in-depth discussion of the truth conditions imposed by be-
fore and after, as well as a cross-linguistic typological survey. My goal is to provide information about which asymmetrical differences between before and after are language-specific (and putatively semantic) and which are language-general (and therefore more appropriately characterized as attributable to pragmatics or metaphysics). I then propose an account that characterizes before and after as antonyms, and couples independently motivated aspectual coercion operations with a domain-general notion of maximal informativity. I argue that this account correctly characterizes the truth conditions of before and after sentences, and can be implemented, as other theories have, to account for NPI and veridicality issues.

2. Asymmetries between before and after

While Anscombe (1964) discussed several asymmetries between before and after constructions, the more recent consensus (starting with Heinämäki, 1974; Ogihara, 1995) is that the temporal relations differ in two main respects: after – but generally not before – entails its internal argument (the ‘veridicality asymmetry’); and before – but generally not after – licenses NPIs in its internal argument (the ‘NPI asymmetry’). I’ll present these central differences before discussing the truth conditions of before and after constructions in Section 2.3.

2.1. The veridicality asymmetry

The canonical illustration of the veridicality asymmetry between before and after is in (1) (from Beaver and Condoravdi, 2003).

(1) a. Mozart died before he finished the Requiem. → Mozart finished the Requiem.
    b. Mozart died after he finished the Requiem. → Mozart finished the Requiem.

In (1) the proposition associated with internal argument – the clause ‘he finished the Requiem’ – is entailed by (1b) but not by (1a). In event-semantic terms, the eventuality associated with the internal argument is actualized in (1b) but not in (1a). Several, beginning with Heinämäki (1974), differentiate between two non-veridical interpretations: those compatible with a non-actualized embedded event (a ‘neutral’ reading), and those that entail a non-actualized embedded event (a ‘counterfactual’ reading).

There is a surprising amount of variation of judgment regarding which before sentences are veridical and which are not. Heinämäki (1974) argues that veridicality is conditioned by real-world knowledge triggered by the main clause verb (e.g. died); by the aspect of the main clause (claiming non-veridical constructions must have non-stative main clause verbs); by NPIs (compare I left the country before something/anything happened); and by ellipsis in the embedded clause (compare John left before Bill did with John left before Bill). Many of these claims have been challenged; Condoravdi (2010) goes so far as to argue that the (non-)veridicality of a before sentence is so context-sensitive that it cannot even be reliably tested for its status as an implicature or a presupposition.

2.2. The NPI asymmetry

There is, generally speaking, an asymmetry between before and after with respect to their ability to license negative polarity items (NPIs) in their embedded argument (Heinämäki, 1974; Ogihara, 1995). This is exemplified in (2).
As extensively argued in Condoravdi (2010), this asymmetry is predicted assuming that NPIs are licensed in Strawson downward-entailing environments (von Fintel, 1999): those in which an inference from an argument to its subset (here, both temporal arguments) is licensed as long as the context of evaluation supports the presuppositions of both.

There is, however, an intriguing exception to the asymmetry illustrated in (2): NPIs are also licensed in *after* constructions, provided *after* is modified by *long* or some other modifier requiring a significant amount of time to pass between the eventualities associated with the embedded and main clauses. (The data in (3) are adapted from Krifka 2010b.)

(3) Jo kept writing poems {many years / ?three years / ??three days} after there was any hope of getting them published.

As will be discussed in Section 2.3, some *after* sentences are ambiguous between requiring that the eventuality associated with the main clause succeed the *initial* point of the eventuality associated with the embedded clause, or its *final* point. Condoravdi (2010) convincingly argues that only the latter reading is (Strawson-)downward-entailing, and that modifiers of *after* render the sentence unambiguously ‘after final’.

While these conclusions seem correct, they do not account for the ‘significant length’ requirement illustrated in (3). Specifically, Condoravdi predicts that all three modified *after* sentences will be equally acceptable. Krifka (2010b) uses that shortcoming to argue that the theory of NPI-licensing introduced in Krifka (1995) – which employs the notion of strong alternatives, rather than semantic presuppositions – is a more appropriate explanation of NPI-licensing in temporal relations.

#### 2.3. Truth-conditional differences

In what follows I’ll use the term ‘eventuality’ to range over states and events of any sort. I will use the aspectual typology from Moens and Steedman (1988), which differentiates between events that are points (i.e. semelfactives, like *hiccup*); culminations (i.e. accomplishments, like *recognize*); processes (i.e. activities, like *swim*); and culminated processes (i.e. achievements, like *swim to shore*). While Moens and Steedman differentiate between events and states – and this is a useful distinction – I will extend the term ‘process’ to include states, as the distinction between activities like *swim* and states like *know English* will be immaterial in what follows. I’ll use the term ‘main eventuality (ME)’ to refer to the eventuality associated with the main or matrix clause in a *before* or *after* sentence, and the term ‘embedded eventuality (EE)’ to refer to the one associated with the embedded clause.

There has been relatively little direct discussion of the truth conditions of *before* and *after* constructions, with the exception of Heinämaäki (1974), who explicitly discusses truth-conditional differences conditioned by aspect. Taking a cue from Heinämaäki, I’ve found it useful to differentiate between two types of *before* and *after* sentences:

(4) **unambiguous before and after sentences**

a. culminated ME *before* process EE:
   John met Mary *before* she was president.  

< initial
b. culminated ME after culminated EE:
   John met Mary after she climbed the mountain. ➔ final

(5) ambiguous before and after sentences
a. culminated ME before culminated EE:
   John met Mary before she climbed the mountain. ≺ initial, ≺ final
b. culminated ME after process EE:
   John met Mary after she was president. ➔ initial, ➔ final

The sentences in (4) are clearly unambiguous: in order for (4a) to be true, John needs to have met Mary before her first day in office; the sentence is false if he meets her halfway through her term. And in order for (4b) to be true, John needs to have met Mary after she summited the mountain; the sentence is false if he meets her halfway up the mountain, i.e. after she has begun climbing the mountain. While I’ve illustrated these truth conditions using a stative EE (for (4a)) and a culminated process EE (for (4b)), the intuitions should extend to process or activity EEs and culminations or accomplishment EEs, respectively.

In contrast the sentences in (5) are ambiguous. This has been previously acknowledged Heinämäki (1974); Condoravdi (2010) for (5b), but as far as I can tell, the ambiguity in (5a) has gone unnoticed. It nevertheless exists: in English, at least, (5a) is compatible with a scenario in which John and Mary meet halfway up the mountain, i.e. before she has summited (the ≺ final interpretation), and it is also compatible with a scenario in which John and Mary meet on the bus on the way to the base of the mountain (the ≺ initial interpretation). Similarly, (5b) is compatible with a scenario in which John met Mary after she’d retired from politics (the ➔ final interpretation), as well as a scenario in which the meeting occurred while she was in office (the ➔ initial interpretation).

It is worthwhile acknowledging the entailment relation between each of these readings. For the before sentence in (5a), ≺ initial entails ≺ final; for the after sentence in (5b), ➔ final entails ➔ initial. One might nevertheless be tempted to characterize the available readings in (5) as a matter of semantic underspecification rather than ambiguity. (Anscombe (1964) explicitly makes this argument, albeit with diagnostics that don’t seem compatible with how linguists today characterize the difference.) But I characterize it as an ambiguity for several reasons: first, native speakers report the intuition that the two readings are distinct, i.e. available in different contexts; and second, as I will mention in Section 2.4, languages use aspectual marking to disambiguate between the two interpretations in a way that mirrors aspectual coercion, which is how Heinämäki (1974) and Condoravdi (2010) viewed the ambiguity in (5b).

In sum, given (4) and (5), we see the truth conditions illustrated in Table 1.²

Notably, Table 1 shows no clear bias across the spectrum of before and after constructions towards the initial or earliest point of the embedded eventuality. In other words, Table 1 offers no justification for an EARLIEST operator in the absence of a LATEST operator (cf. Beaver and Condoravdi, 2003), or an earliest operator coupled with a MAX operator that predicts an additional after ambiguity but not an additional before ambiguity (cf. Condoravdi, 2010).

²Although see Section 4 for a discussion of some subtleties in the truth conditions of constructions in which both the ME and EE are states or non-culminating processes.
I will briefly discuss cross-linguistic variation in the semantics of these constructions before evaluating these theories in a little more detail in Section 2.5.

2.4. Cross-linguistic variation in before and after constructions

I conducted an informal typological survey on the syntax and semantics of before and after constructions. It surveyed 17 languages (including English) from seven different language families, listed below.

(6) Afrosiatic: Hebrew; Austronesian: Tagalog; Indo-European: Dutch, English, German (Germanic); Greek (Hellenic); French, Italian, Spanish (Romance); Russian, Serbo-Croatian, Slovenian (Slavic); Japonic: Japanese; Sino-Tibetan: Mandarin; Turkic: Turkish; Uralic: Estonian, Hungarian

The survey strongly suggests that the veridicality and NPI asymmetries are universal. Speakers of all languages reported a veridicality asymmetry for sentences like the ones in (1). And each language either didn’t license NPIs under temporal prepositions (e.g. Greek, Spanish) or only licensed NPIs under before (not after). This, in turn, suggests that both asymmetries should receive a treatment that does not predict cross-linguistic variation.

The universality of the truth conditions of before and after constructions is a little harder to determine, in part for several reasons that are rooted firmly in morphosyntax: i) as demonstrated in del Prete (2008), languages can in principle use degree-based ‘earlier’ and ‘later’ strategies for expressing temporal precedence and succession, rather than the temporal relation strategies encoded in before and after; ii) as Sharvit (2014) shows, languages can differ in how they interpret past tense in embedded clauses; and iii) perhaps surprisingly, there is tentative evidence that languages also differ in whether they allow stative EEs in before and after constructions.

Regarding the latter: while English licenses stative EEs under both before and after, but other languages (like Russian and Japanese) were reported to disallow stative EEs under either (7). And still other languages (like Dutch and Hungarian) appear to disallow stative EEs, but only

<table>
<thead>
<tr>
<th>process EE</th>
<th>example</th>
<th>culmination EE</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A before B</td>
<td>≺ initial</td>
<td>(4a)</td>
<td>≺ initial</td>
</tr>
<tr>
<td>A after B</td>
<td>⊳ initial</td>
<td>(5b)</td>
<td>⊳ final</td>
</tr>
</tbody>
</table>

Table 1: truth conditions of before and after sentences

3Although see del Prete (2008) for an interesting discussion of some complications in Italian.
4My Russian consultants commented that each would be acceptable with an embedded inchoative marker.
under *after* (not *before*). For these languages, consultants reported that the *after* sentences are degraded without an inchoative marker, and were unable to offer a characterization of its truth conditions without an inchoative marker. In contrast, I found no language that disallowed stative EEs under *before* but not *after*.

(8) a. Mary azelőtt találkozott Johnnal, hogy egyetemista volt.  
Mary before met John. with that university.student was  
‘Mary met John before he was a university student.’

b. ??Mary azut’an találkozott Johnnal, hogy egyetemista volt.  
Mary after met John. with that university.student was  
Intended: ‘Mary met John after he was a university student.’    

*Hungarian*

For languages without these morphosyntactic differences, I found some evidence of truth-conditional variation. The ambiguity reported in English for *before* sentences with culmination EEs (e.g. (5a)) does not seem to be universal; Dutch, Hungarian, Italian and Tagalog consultants reported that such sentences unambiguously received an ≺ initial interpretation.

(9) Nakilala ni-Mary si-John bago siya um-akyat sa bundok.  
PFV.TV-meet GEN-Mary SUBJ-John before SUBJ.3SG PFV.AV-climb OBL mountain  
‘Mary met John before he climbed to the top of the mountain.’    

*Tagalog*, ≺ initial

And the ambiguity reported in English for *after* sentences with process EEs (e.g. (5b)) does not seem universal, either; in German and Turkish, these sentences were reported to be unambiguously ≻ final.

(10) Mary hat John getroffen, nachdem er Single war.  
Mary had-3SG John met after he single was-3SG  
‘Mary met John after he was single.’    

*German*, ≻ final

Finally, languages that overtly mark aspectual alternations in EE clauses were found to morphologically differentiate between the two readings reported for the constructions in (5). For instance, Serbo-Croatian allows for a perfective/imperfective alternation in embedded temporal clauses, and this alternation (when accepted) seems to condition the interpretation. The perfective version in (11b) has a ≺ final interpretation, and that the imperfective version – to the extent it’s acceptable without an overt inchoative marker – receives a ≺ initial interpretation.

(11) a. Mary je srela Johna pre nego ?to se  
Mary-NOM is-PRES-3FS met-PP-3FS John-ACC before than PTCL REFL  
peo na vrh planine.  
climb-IMP-3MS on top-ACC mountain-GEN.  
‘Mary met John before he climbed to the top of the mountain.’ ≺ initial

b. Mary je srela Johna pre nego ?to se  
Mary-NOM is-PRES-3FS met-PP-3FS John-ACC before than PTCL REFL  
popeo na vrh planine.  
climb-PP-3MS on top-ACC mountain-GEN.  
‘Mary met John before he climbed to the top of the mountain.’ ≺ final

In Tagalog, this difference is conditioned by the neutral, non-culminating perfective (∼ initial) and the culminating perfective (ability-and-involuntary-action, AIA, ≺ final; Dell (1983)).
While these data just underscore the need for much more sophisticated and extensive work on the cross-linguistic variation of before and after constructions across languages, it also speaks in favor of accounts in which ambiguities like those illustrated in Table 1 are dealt with as true ambiguities, on par with the aspectual coercion grammaticized in aspectual markers like those in Serbo-Croatian and Tagalog, rather than semantic underspecification or vagueness. In other words, the close relationship between the acceptability and interpretation of before and after constructions, on the one hand, and grammatical aspect on the other, is predicted by an account in which the interpretation of before and after constructions is explicitly tied to grammatical aspect, instead of pragmatics (or contextual considerations).

2.5. A brief review of extant proposals

Very early analyses of the semantics of before and after have largely been found to be lacking. Anscombe (1964) treats before as encoding a universal quantifier over times introduced by the embedded clause (and after an existential), which Beaver and Condoravdi (2003) point out erroneously predicts that a sentence with a false embedded clause will be predicted to be trivially true. Heinämäki (1974) is the first proposal that seriously considers the subtlety of the truth-conditions, but what it contributes in contextual nuance it lacks in formal sophistication; Beaver and Condoravdi (2003) rightly worry about its inability to deal with temporal modifiers (e.g. eight days before), and Condoravdi (2010) about how it incorrectly ties NPI-licensing to the veridicality of an embedded before clause.

Beaver and Condoravdi (2003) and Condoravdi (2010) (henceforth ‘B&C’) propose a formally complicated account of before and after in which the ME and EE are intrinsically associated with temporal intervals, but strict ordering comes about via operators (ITOP, EARLIEST, and MAX) that coerce the intervals into points. They treat before and after as lexical converses, or antonyms, associated with conversely ordered scales. EARLIEST is a grammaticized manifestation of inchoative coercion, and MAX is an operator proposed in explicit parallel to maximality operators in other domains. They are in complementary distribution. But while they do different things to intervals ordered on the ‘after’ scale, they are neutralized on the ‘before’ scale. EARLIEST and MAX both pick out the initial point of a before EE, but MAX picks out the final point of an after EE.

ITOP – ‘interval to point’ – is used to coerce a telic or culminated EE from an interval to its telos (or, in the case of a plural event with multiple teloi, its latest telos). It is unclear whether this operator is required or optional, given the requirement that EARLIEST or MAX apply, and it’s unclear whether it as an intuitive basis in aspectual coercion, like EARLIEST does.
Unfortunately, while the combination of these three operators correctly predicts most of the possible interpretations of before and after constructions illustrated in Table 1, it cannot predict one: namely the ‘≺ initial’ interpretation of before sentences with culmination EEs, like John met Mary before she climbed the mountain, as in (5a). The embedded eventuality, by virtue of having a telos, is coerced into a single point corresponding to its telos, after which the difference between EARLIEST and MAX is trivial. These predictions are illustrated in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>process EE</th>
<th>B&amp;C account</th>
<th>culmination EE</th>
<th>B&amp;C account</th>
</tr>
</thead>
<tbody>
<tr>
<td>A before B</td>
<td>≺ initial</td>
<td>EARLIEST or MAX</td>
<td>≺ initial</td>
<td>not possible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≺ final</td>
<td></td>
</tr>
<tr>
<td>A after B</td>
<td>⪿ initial</td>
<td>EARLIEST</td>
<td>⪿ final</td>
<td>ITOP</td>
</tr>
<tr>
<td></td>
<td>⪿ final</td>
<td>MAX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: B&C predictions for before and after truth conditions

It is possible in principle for B&C to add a fourth operator, ITOP2, to take a culminated eventuality from its runtime to its initial point, but this innovation would incorrectly predict that after sentences with culminated EEs are similarly ambiguous, which they aren’t. And, quite subjectively, the theory seems complicated enough with only three operators in its inventory.

The B&C account of NPI-licensing and veridicality is particularly well done in Condoravdi (2010), who includes an extensive discussion of veridicality (as e.g. a semantic or pragmatic presupposition) and NPI-licensing. She concludes that the NPI asymmetry is predicted given the notion of Strawson-entailment as a licensing condition (von Fintel, 1999), and can and should be disentangled from the (non-)veridicality of a before construction. Specifically, in the account, NPIs are licensed in before constructions because EARLIEST creates a Strawson-downward-entailing environment in the embedded context, and this remains true on an intensional level regardless of whether the EE occurs in the actual world.

The optionality between EARLIEST and MAX for after constructions has the additional benefit of predicting that some after constructions – namely those that receive ⪿ final interpretations and are thereby derived using MAX – do license NPIs (exceptionally). This prediction, coupled with the assumptions that the truth conditions of after modifiers require a ⪿ final interpretation and that NPIs are licensed only in unambiguously (Strawson-)downward-entailing contexts, accurately predicts that the only after constructions that license NPIs are those that are overtly modified. However, this account cannot predict the observation in (3) (from Krifka, 2010b) that only ‘long’ modifiers license NPIs under after; it incorrectly predicts that NPIs are just as acceptable under right after as they are under long after.

In his response to Condoravdi (2010), Krifka (2010b) proposes a different approach with what he touts as several advantages: it avoids likening multiple interpretations of before and after sentences to aspectual coercion, instead characterizing them as instances of semantic under-specification; it avoids the use of possible worlds in his semantics; and he eschews Strawson-entailment as a licensing condition for NPIs in favor of the one advocated for in Krifka 1995, in which NPIs come about via the use of a semantically weak proposition compared to its alternatives.

The latter represents a clear improvement over the B&C approach for its ability to predict
the (gradient) differences in acceptability of NPIs under *after* modifiers of various lengths, as illustrated in (3). But the elimination of possible worlds in the theory is of minimal advantages to those of us who endorse their use in general, and leaves us in a relatively unsatisfying position in terms of correctly characterizing the truth conditions of these sentences.

For Krifka, *before* and *after* are lexical converses or antonyms, associated with conversely but non-strictly ordered scales, as in (13).

\[(13) \quad \begin{align*}
\text{a. } [\text{before } B] &= \lambda t \rightarrow \exists t'[t \leq t \land [B](t')] \\
\text{b. } [\text{after } B] &= \lambda t \exists t'[t \leq t \land [B](t')] 
\end{align*}\]

He highlights as a happy outcome the parallels between the meaning in (13a) and the degree-semantic meaning of Italian *prima* (‘earlier’) proposed in del Prete (2008). But that proposal came from idiosyncratic properties of *prima* in relation to English *before* and also in relation to Italian *dopo* (‘after’). Krifka’s analysis of both *before* and *after* as akin to *prima* incorrectly ignores these differences, and parallel differences in English between *before* and *after*, on the one hand, and *earlier* and *later*, on the other.

The relatively semantically underspecified entries in (13) also require a reliance on what Krifka refers to as ‘pragmatics’: the derivation of various implicatures to produce either the multiple meanings associated with some *before/after* constructions, or the relatively narrow meaning associated with them, depending on the context of utterance. For instance, the veridicality in (1a) (*Mozart died after he finished the Requiem*) comes from a conversational implicature that the EE (the *B* argument) is “reasonably probable” (p. 920), the result of what would otherwise be an “unmotivated restriction” (ibid.) that *B* is not true at any time before *A*. The non-strict ordering lexically encoded in both entries in (13) turns into a strict-ordering as the result of an implicature associated with the competition of both relations with *when*, which just requires overlap. And, finally, *before* and *after* compete with each other (p. 922), which generates, for each, an implicature that the other is not appropriate, which can optionally constrain the truth conditions as well.

However, there is little precedence for many of these implicatures when we turn to related phenomena. In degree semantics, it is largely assumed that the non-strict equative (*as Adj as*) competes with the strict comparative (*Adj-er than*), resulting in the former carrying an implicature that the strict comparison is not true (Rett, 2014). Analogously, this would predict that *when* – the semantically weaker of the relations – carry a Quantity implicature, not *before* or *after*. Similarly, if *before* and *after* are in fact antonyms – and further if *before* is the marked, negated version of *after*, as Krifka argues – the clear prediction is that only the marked antonym carries the Manner implicature, not that they are both symmetrically associated with an implicature (Rett, 2015b). The weakness of these pragmatic explanations, coupled with the relatively weak truth conditions imposed by (13), arguably over-generate the truth conditions in Table 1, predicting, for instance, that *before* sentences with stative or process EEs (e.g. *John met Mary before she was president*, (4a)) is ambiguous, like its culmination EE counterpart (5a).

### 3. A more general proposal

In what follows, I will characterize *before* and *after* in a way that closely parallels the semantic treatment of relations in other ordered domains: they will be context-sensitive, but more impor-
tantly they will be polar-sensitive, sensitive to the temporal ordering of their arguments. The result is an analysis that correctly predicts the truth conditions in Table 1; has the same capacity as the account in Condoravdi (2010) to address the veridicality and NPI asymmetries (for the same reasons); and involves only independently motivated components: 1) a treatment of before and after as antonyms, associated with scales with reverse orderings (and a scale-sensitive characterization of maximality); 2) two aspectual coercion mechanisms.

3.1. Order-sensitivity in the degree domain

Just as before and after relate two temporal intervals, antonymic comparatives like taller and shorter relate two degree intervals. The relations therefore have a lot in common; I will focus on those commonalities here and draw conclusions about the semantic treatment of temporal relations from the canonical treatment of comparatives.

But I will note that there are important morphosemantic differences between temporal relations like before and after and adjective-based comparatives like earlier and later. The morphological differences are relatively transparent; the semantic differences, highlighted in a very useful study in del Prete (2008), range from subtle to obvious (e.g. earlier and later, qua comparatives, both license NPIs in their embedded arguments, and so do not have an NPI asymmetry). So the goal of this section is to explain what sorts of lessons we can draw from comparatives – qua relations between strictly ordered arguments – without reducing the analysis of before and after to a degree-comparative-based analysis of earlier and later (cf. Krifka (2010b)).

3.1.1. Cross-polar anomaly

Kennedy (1997) observes that, while comparatives can be formed with two distinct adjectives or parameters (14), these adjectives can differ with respect to dimension of measurement, but they cannot differ only with respect to polarity (15).

(14)  a. A is taller than B is wide.
    b. A is more tall than B is wide.

(15)  a. *A is taller than B is short.
    b. *The hose is shorter than the ladder is long.

The generalization he comes to (although see Büring, 2007) is that comparatives can only relate two arguments with the same ordering. This means that, even in a typical (one-adjective) clausal or even phrasal comparative, we can assume both arguments are ordered along the same scale. This is arguably intuitive, in an apples-to-oranges sense, and is what I will carry over to the treatment of before and after.

There is widespread agreement that positive antonyms (like tall) are associated with a scale consisting of points (modeled by [0, ∞), the positive numbers) on a greater-than (>) ordering. There are consequently two different ways of characterizing negative antonyms. One is to maintain that negative antonyms, too, range over positive numbers, but encode the opposite scale, less-than (<; Option 1 in Table 3).

A second option is to characterize negative antonyms, too, as encoding the greater-than ordering, but to characterize them as instead ranging over points corresponding to the negative numbers (Option 2 in Table 3).
The latter is familiar from work on comparatives in Rullmann (1995) and Heim (2000), but translates less intuitively to the domain of times, in which the concept of negative times seems less intuitive. I will therefore characterize negative antonyms (like short, but also before) along the lines of Option 1: as associated with converse scales, but the same domain of time points. This, coupled with the restrictions illustrated by cross-polar anomaly, will require that we relativize the notion of maximality to the scale associated with the plural it ranges over.

### 3.1.2. Scale-sensitive maximality

As discussed in detail in Rullmann (1995), there seem to be a wide variety of natural-language phenomena whose semantic interpretations require a notion of maximality. These include comparatives, like John swam faster than Bill could run, and degree questions, like How many children does John have?. It is in principle possible to model the semantics of these constructions without a maximality operator – by i.e. characterizing the comparative as a strict subset relation, or using the Gricean notion of Quantity to capture strong exhaustivity, even in embedded questions – but Rullmann argues that the use of a maximality operator can account for semantic subtleties (e.g. negative island effects in comparatives) that the others can’t. He proposes something like (16), for a plurality \( X \) in any domain.

\[
\text{(16)} \quad \text{MAX}(X) = \forall x \in X \wedge \forall x' \in X \[(x' \neq x) \rightarrow x R x']
\]

Of course, a maximality operator is just as necessary in comparatives with negative antonyms (like John swam slower than Bill could run) as it is in comparatives with positive antonyms. And, as Beck and Rullmann (1999) point out, it is needed for degree questions formed with upward-scalar predicates, like How much money can a graduate student live on?. This notion of maximality takes for granted that both positive and negative antonyms order along the ‘greater than’ scale (with negative numbers), as in Option 2 in Table 3 above. To adapt it for Option 1, we will need to define maximality in a scale-sensitive way. This is done in (17), where \( R \) ranges over the relations \( >, < \).

\[
\text{(17)} \quad \text{MAX}(X_R) = \forall x \in X \wedge \forall x' \in X \[(x' \neq x) \rightarrow x R x']
\]

This amounts to a local (i.e. non-propositional) implementation of the widely recognized need for a notion of ‘maximal informativity’ as opposed to maximality writ large (Dayal, 1996; Beck and Rullmann, 1999; von Fintel et al., 2014); it outputs \( n + 1 \) over \( n - 1 \) for a ‘greater than’ scale and \( n - 1 \) over \( n + 1 \) for a ‘less than’ scale.

### 3.2. Aspectual coercion

A final piece of the puzzle here is the importing of two independently motivated aspectual coercion mechanisms (de Swart, 1998): one for non-culminating processes (like states and activities), and another for culminated processes (like achievements and accomplishments).
The first is inchoative coercion, an interpretive option for states and activities. It captures the observation that processes can denote an interval corresponding to their entire runtime, as in (18a), or a single point corresponding to the onset or initial point of that interval, as in (18b) (interpreted as meaning that the start of Amy’s surprise happened when Betty paid the check).

(18) a. Amy was surprised.  \hspace{2em} \textit{stative}

b. Amy was surprised when Betty paid the check.  \hspace{2em} \textit{inchoative}

Inchoative coercion is formalized in (19) (Dölling, 2014); several languages, like Russian, employ inchoative aspect markers (e.g. -sja) to derive the meaning in (18b) (Hamburger, 1984; Haspelmath, 1993).

(19) \textit{inchoative coercion}: If \( e \) is a process with duration \( T \), \( e \) can denote \( T \) or \( \text{GLB}(T) \), where \( \text{GLB}(T) = \{ t \in T \land \forall t' \in T [t \leq t'] \} \)

The second is completive coercion, a known interpretive option for accomplishments and achievements (i.e. telic eventualities or culminated processes; Dölling (2014)). In (20a), the accomplishment denotes an extended temporal interval; in (20b), it denotes a single temporal point associated with the telos, or culmination, of the accomplishment.

(20) a. Jane climbed the mountain.  \hspace{2em} \textit{accomplishment}

b. Jane climbed the mountain at seven o’clock sharp.  \hspace{2em} \textit{semelfactive}

(21) \textit{completive coercion}: If \( e \) is a culmination with duration \( T \), \( e \) can denote \( T \) or \( \text{LUB}(T) \), where \( \text{LUB}(T) = \{ t \in T \land \forall t' \in T [t \geq t'] \} \)

I will assume that these coercion mechanisms, like any polysemy, can apply optionally to their arguments whenever context or aspectual marking allows. This means that, although the data in Table 1 are presented assuming that the main clause eventuality is punctual, the theory presented below predicts a broader range of truth conditions (process ME \( \times \) process EE; process ME \( \times \) culmination EE; culmination ME \( \times \) culmination EE; culmination ME \( \times \) process EE), including optional aspectual variation for each argument. I have reason to believe these broader predictions are correct, but do not have the space to present them in detail here.

3.3. The formal analysis

The formal analysis of temporal relations I propose combines these assumptions: the assumption (from cross-polar anomaly) that antonyms are associated with reverse orderings; the assumption that maximality operators are scale-sensitive; and the assumption that inchoative coercion and completive coercion can apply optionally to processes and culminations, respectively. Specifically, I propose that \textit{before} and \textit{after} encode reverse relations between some point in their matrix argument (here, \( A \)) and the most informative point in their embedded argument (here, \( B \)). In this sense, they are lexical converses, or antonyms, just as they are in Beaver and Condoravdi (2003), Condoravdi (2010), and Krifka (2010b).

(22) a. \([A \text{ before } B] = \exists t \in A [t < \text{MAX}(B_\prec)]\)

b. \([A \text{ after } B] = \exists t \in A [t > \text{MAX}(B_\succ)]\)

In (22a), \textit{before} relates some point in the matrix eventuality \( A \) to the maximal (on the ‘before’ ordering) time associated with the embedded eventuality \( B \). And in (22b), \textit{after} relates some point in the matrix eventuality \( A \) to the maximal (on the ‘after’ ordering) time associated
with the embedded eventuality \( B \). A metalinguistic constraint – identical to the one needed to account for cross-polar anomaly – requires that the matrix and embedded temporal interval arguments both be ordered on the same scale as the one associated with the relation in order for the sentences to be defined.

### 3.3.1. The truth conditions

Direct application of the definitions in (22) account for four of the six possible interpretations of \textit{before} and \textit{after} sentences; incorporation of the two types of aspectual coercion account for the other two. I will begin by discussing the two ambiguous examples.

<table>
<thead>
<tr>
<th>process EE</th>
<th>example</th>
<th>derivation</th>
<th>culmination EE</th>
<th>example</th>
<th>derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A ) before ( B )</td>
<td>( &lt; ) initial</td>
<td>(4a)</td>
<td>(22a)</td>
<td>( &lt; ) initial</td>
<td>(5a)</td>
</tr>
<tr>
<td>( A ) after ( B )</td>
<td>( &gt; ) initial</td>
<td>(5b)</td>
<td>(18)+(22b)</td>
<td>( &gt; ) final</td>
<td>(4b)</td>
</tr>
</tbody>
</table>

Table 4: predicting the readings of \textit{before} and \textit{after}

The sentence in (5a) is repeated in (23). Assume that John met Mary at 3pm, and that Mary climbed the mountain from 1pm to 4pm (i.e. that \( B = [1pm, 4pm] \)). The \( < \) initial interpretation of this sentence comes from a direct application of (22a): the meeting time, 3pm, is related (on the precedence scale) to the earliest time in the EE interval (the time that imposes the strongest restriction on the temporal precedence relation). In this context, that reading is false (23a).

(23) John met Mary before she climbed the mountain.

\begin{align*}
\text{a.} & = 3pm & < & \text{MAX}( [1pm, 4pm]_- ) \\
& = 3pm & < & 1pm & < & \text{initial: false} \\
\text{b.} & = 3pm & < & \text{MAX( compleitive([1pm, 4pm]_- ))} \\
& = 3pm & < & \text{MAX( [4pm]_- )} \\
& = 3pm & < & 4pm & < & \text{final: true}
\end{align*}

The \( < \) final interpretation of this sentence comes from an application of completive coercion, appropriate because the embedded eventuality is a culmination. The temporal interval is first coerced into a singleton point representing its telos, and then \textit{MAX} is trivially applied (in accordance with (22a)). The prediction is that the sentence is true iff 3pm indeed precedes 4pm, which it does.

The sentence in (5b) is repeated in (24). Assume that John met Mary in 2022, and that Mary was president from 2021-2028 (i.e. that \( B = [2021 – 2028] \)). The \( > \) final interpretation of this sentence comes from the application of the maximality operator, which picks out the latest time in the EE interval, i.e. temporal endpoint. The result is a false reading of the sentence that claims that 2022 comes after 2028.

(24) John met Mary after she was president.

\begin{align*}
\text{a.} & = 2022 & > & \text{MAX( [2021 – 2028]_+ )} \\
& = 2022 & > & 2028 & > & \text{final: false} \\
\text{b.} & = 2022 & > & \text{MAX( inchoative([2021-2028]_+) )} \\
& = 2022 & > & \text{MAX( [2021]_+ )}
\end{align*}
= 2022 ≻ 2021

The ≻ initial interpretation of this sentence comes from an application of inchoative coercion, appropriate because the embedded eventuality is a process. The temporal interval is first coerced into a singleton point representing its temporal onset, and then MAX is trivially applied (in accordance with (22b)). The prediction is that the sentence is true iff 2022 comes after 2021, which it does.

Crucially, this account correctly predicts that two of the logically possible eight readings are unavailable. Before constructions with embedded processes cannot receive a ≺ final interpretation, because that interpretation would require an aspectual coercion mechanism from a state to its endpoint, which is unattested. This asymmetry results from the facts that before privileges the greatest lower bound of the embedded interval and that processes cannot override this reading by coercing into a least upper bound point. And after constructions with embedded culminations cannot receive a ≻ initial interpretation, because that would require an aspectual coercion mechanism from a telic eventuality to its beginning point, which is unattested. This asymmetry results from the facts that after privileges the least upper bound of the embedded interval and that culminations cannot override this reading by coercing into a greatest upper bound point.

And finally, the fact that this account relies on aspectual coercion mechanisms for two of the six available readings correctly predicts that languages like Russian, Serbo-Croatian, and Tagalog can disambiguate between the two readings for (5a) and (5b) using aspectual markers (like inchoative or completive markers, or perfective, etc.). This capability seems encouraging for an explanation of the fact that some languages differ in whether their before and after are in fact ambiguous in the ways English ones are, but I cannot account for such cross-linguistic variation here.

3.3.2. The universal asymmetries

In general, the present proposal accounts for the veridicality and NPI asymmetries just as Con- doravdi (2010) does. Specifically, I will assume a branching theory of time in which past times can be evaluated in the actual world, but future times are necessarily modal. This, assuming intensionalized versions of before and after in (22), accounts for the observed veridicality asymmetry. It also, incidentally, accounts for the universality of the veridicality asymmetry: because the indetermination of the future is the same for every language, before is necessarily intensional, and its embedded eventuality is therefore not necessarily actualized.5

The current proposal also predicts that NPIs are licensed (given a Strawson-entailment characterization of NPI-licensing, von Fintel 1999) in before and after constructions but only under certain conditions.

As Figure 1 illustrates, aside from instances of completion coercion, whenever $B'$ is a subset of $B$, $A \prec \text{MAX}(B)$ entails $A \prec \text{MAX}(B')$ (i.e. if some point in $A$ precedes the initial point of $B$, it necessarily precedes the initial point of $B'$). But this entailment relation does not hold if the point in $A$ is related to the final points of $B$ and $B'$. So the account predicts that before

5While Heinämäki (1974) argues that veridicality is conditioned by syntactic phenomena like NPIs and ellipsis, this doesn’t ring true to me, nor is this claim endorsed by further analyses. Specifically, I can get a veridical reading for I left the country before anything happened, and a non-veridical reading for John left before Bill.
constructions with process EEs, like (25a), license NPIs, and that before constructions with culmination EEs, like (25b), license NPIs, but only when they necessarily receive a ≺ initial interpretation.6

(25)  
   a. John met Mary before she ever was president.       ≺ initial
   b. John met Mary before she ever climbed the mountain. ≺ initial or ≺ final

And this indeed seems to be the case: (25b) cannot be used to accurately describe a situation in which John met Mary halfway up the mountain, i.e. after she summited the mountain. It remains to be seen whether this new observation is cross-linguistically robust (in other words, whether the universal NPI asymmetry reported above includes this nuance involving ≺ final interpretations of before constructions).

I’ll just highlight that this prediction is novel to the present analysis precisely because it is the first to explicitly account for initial/final ambiguities in before constructions. As indicated by the parallel scenario in Figure 1 – and knowing that after constructions are also initial/final ambiguous – my analysis predicts that after can license NPIs, but only in sentences that unambiguously receive ≻ final interpretations. Figure 1 illustrates this downward-entailing property: whenever B’ is a subset of B, A ≻ MAX≺ (B) entails A ≻ MAX≺ (B’) (i.e. if some point in A succeeds the final point of B, it necessarily succeeds the final point of B’). But this entailment relation does not hold if the point in A is related to the initial points of B and B’, and therefore we can conclude that after constructions that are ambiguous between ≻ initial and ≻ final interpretations cannot license NPIs.

This is precisely the prediction made by the account in Condoravdi (2010).7 However, in contrast to the analogous prediction about (25), this seems to be incorrect. Both constructions in (26) are characterized as ungrammatical, regardless of their interpretation.

(26)  
   a. *John met Mary after she ever climbed the mountain. ≻ final
   b. *John met Mary after she ever was president.        ≻ initial or ≻ final

This is an unsatisfactory state of affairs, but it is in keeping with those made in Condoravdi (2010). And while Krifka (2010b) proposes an alternative account that makes better predictions regarding NPIs (and especially exceptional NPI-licensing), his account is lacking in a number

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6It is typical to test NPI any in these embedded clauses, but I have chosen to use ever because any necessitates a verbal object, which has hard-to-control-for implications for the aspectual class of the embedded clause.

7I also inherit from her, in the absence of any other theoretical modification, the prediction that all modifiers of after equally license NPIs, which does not seem to be the case, as demonstrated in (3) (Krifka, 2010b).
of other areas. So I will have to leave this issue unsettled for now.

4. Conclusion and discussion

Previous accounts of the semantics of before and after constructions have focused on the veridicality and NPI asymmetries between the two relations (Beaver and Condoravdi, 2003; Condoravdi, 2010; Krifka, 2010b). The assumptions in these papers regarding the truth conditions of the constructions have been unclear and incomplete. I have provided a little more scrutiny of the possible interpretations of before and after constructions, in English and other languages, and come to several novel empirical conclusions: the NPI and veridicality asymmetries are universal, and so should not be attributable to language-specific idiosyncrasies; there is no reason to think that these constructions bias the initial point of the embedded clause in any way (cf. Table 1); and after constructions are not unique in their ambiguity. I’ve also suggested that languages differ in the ambiguity of their before and after constructions, in a way that arguably tracks independent differences in aspectual marking and the interpretation of grammatical aspect. So at least some component of an analysis of the truth conditions of before and after should be appropriately aspectually sensitive.

The account presented here draws from the degree-semantics literature; in particular, from what we know about antonymic relations between ordered intervals in the degree domain. I adopt from that phenomenon (and from Kennedy, 1997) the assumption that both interval arguments of a relation must have the same ordering as the relation itself, and that any notion of maximality used to interpret these relations must be sensitive to the scale ordering of that interval.

The result is an account in which before privileges the initial point of its embedded argument and in which after privileges the final point of its embedded argument. When these definitions are combined with two known types of aspectual coercion – inchoative coercion for processes (states or activities), and completive coercion for culminations (achievements or accomplishments) – the account predicts all and only the six available interpretations of before and after constructions illustrated in Table 1. It also predicts that languages which employ aspect to overtly mark these aspectual coercion processes, like Serbo-Croatian (11), have correspondingly unambiguous before and after constructions.

Incidentally, as argued in Rett (2015a), this combination of scale-sensitive maximality and pragmatic processes that can make certain endpoints contextually salient predicts that relations between intervals are similarly ambiguous across strictly ordered domains. Specifically, it predicts the fact that positive comparatives like faster are generally unambiguously > max, while negative comparatives like slower are generally ambiguous between a < min and a < max interpretation, as illustrated in the famous Lucinda sentences (Rullmann, 1995). The context-sensitivity of the coercion mechanisms – and their cross-domain counterparts – can also account for the observation that these ambiguities vary contextually (Beck, 2012).

As I argue in Rett (2015a), the parallel also carries over to locative prepositions, which can be thought of as relations between strictly-ordered spatial intervals, or vectors. The positive relation above in (28a) can only be interpreted as placing the bird above the top, or canopy, of
the tree; but the negative relation *under* in (28b) is ambiguous between a reading in which the bird is flying somewhere under the canopy (the < top interpretation) or, more darkly, buried in the ground beneath the roots of the tree (the < bottom interpretation).

(28) a. The bird is above the tree.  > top
b. The bird is under the tree.  < top or < bottom

While the parallels are not absolute (recall that there is no NPI asymmetry in comparatives), I believe the truth-conditional similarities are similar enough to constitute evidence for a characterization of all antonyms as encoding scale reversals; all maximality operators as being scalesensitive; and for there to be some degree of optionality, in strictly ordered domains, about whether the interval as a whole is available for a relation, or just a particular salient endpoint.

There are several adjacent phenomena I haven’t had the opportunity to discuss. Condoravdi (2010) and Krifka (2010b) spend an admirable amount of time extending their treatments of *before* and *after* to the temporal relations *since* and *until*, which seem similarly antonymic. (*Since* sentences, like *after* sentences, situate the runtime their matrix eventuality after the runtime of their embedded eventuality, while *until* does the opposite.) I am optimistic that the general points of the present proposal extend naturally to *since* and *until* constructions, as do Condoravdi’s and Krifka’s accounts, but have not examined them in detail. Finally, I have left unaddressed at least one other intriguing cross-linguistic difference between *before* and *after*: *before* constructions, but not *after* constructions, can be formed with spurious negation, or expletive negation, in languages like German (Krifka, 2010a) and Mandarin (Lin, 2016).

References

The Game of Same and Different — A Framework for Analyzing Determiner Systems¹
Gerhard SCHADEN — Université de Lille & CNRS UMR 8163 STL

Abstract. This paper proposes to extend the Game of Same and Different (introduced by Grønn and Szæbø, 2012), and to transform it into a general framework for reasoning about determiner systems in natural languages. The system is applied to a Latin-like language with a singular-plural system and no articles. It will be shown that the system converges under highly rational agents toward the use of the demonstrative as a definite article, and against the emergence of an indefinite article. The behavior of agents more limited in their rationality is explored, and compared with the diachronic development of definite and indefinite articles. Finally, the underlying assumptions of the model are checked against two Latin texts.

Keywords: Determiner Systems, Definite Article, Indefinite Article, Rational Speech Act Model.

1. Introduction

One core idea of structuralism in linguistics is that linguistic items form systems, where the behavior and distribution of a linguistic expression are not only determined by its intrinsic meaning, but also by the meanings of other items it competes with (see Jakobson, 1971 for an application to verbal categories). While the intuition itself has come back into favor in recent years (see, e.g. Sauerland, 2008b), as far as I am aware, there has been no attempt as complete as the one by Jakobson in order to account for a reasonably complex, and possibly full, linguistic subsystem. One of the reasons is the wealth of interacting constraints, which are difficult to reason through verbally with any degree of confidence. This paper proposes to overcome these difficulties by providing a framework for determiner systems in natural languages, using a Rational Speech Act (henceforth RSA) solution concept² (see, e.g., Franke, 2017).

The idea that determiners form a system is not a new one. For instance, it has been known at least since Hawkins (1991) that the availability of a definite article in a given grammatical context has an impact on the meaning effects triggered by the indefinite article in that context, as is illustrated in (1) vs. (2) (see Grønn and Szæbø, 2012; Amsili and Beyssade, 2016).

(1) I met a wife of John.
   ⇝ John has/had multiple wives

(2) John has a wife.
   ∴ John has multiple wives

(3) a. I met the wife of John/John’s wife.

¹I would like to thank the reviewers and the audience at Sinn und Bedeutung in Osnabrück for their feedback and criticism. Furthermore, I would like to thank Lieven Danckaert, Michael Franke, and Igor Yanovich. Without their help and discussion, this article would either not have been written at all, or it would look very different.

Finally, my gratitude goes to the two Hiwis who proofread this paper, and who pointed out several errors. All remaining typos and errors are mine alone.

All counts, diagrams and data manipulation have been performed with Python 3.

²The pragmatic part of the game could be implemented with minor changes in an Iterated Quantal Response framework, although not in a Iterated Best Response framework (see, e.g., Franke and Jäger, 2014).

b. #John has the wife.

For instance, in some contexts – as exemplified in (1) – an indefinite article triggers a non-uniqueness inference. However, as is shown by (2), this inference is not systematically triggered by the English indefinite article. The difference is explained by the fact that in the grammatical context of (1), the definite article could be felicitously used (see (3a)), whereas this is not the case for (2), since (3b) cannot mean that John is married to a unique woman.

A similar phenomenon comes from the semantics of plurals (see, e.g., Link, 2000). Intuitively, the use of a plural seems to indicate that we are faced not with one, but with several instantiations of a predicate (see (4)):

(4) a. John owns a house.
   b. John owns houses.

However, there are good reasons to assume that plurals in languages like English do not exclude singletons from their denotation (a view known as “inclusive plural”):

(5) Do you have children?
   a. Yes, one.
   b. #No, one.

Assuming that the speaker has exactly one child, the appropriate answer to (5) has to be (5a), and cannot be (5b). If the meaning of the plural excluded the atoms (here: individual children), one would expect the truthful answer to be (5b), and not (5a). This once again points to the idea that in many instances a plural is infelicitous because there is a more specific alternative (namely the singular), and that there is no semantic impossibility of it being used in contexts like (4), in order to denote that John owns a single house.

If we take serious the ideas that determiner systems form systems, we will have to deal with at least these two phenomena, and possibly several others more. As the numbers of competing constraints increase, reasoning them through verbally becomes more and more difficult,3 and therefore, a formal account would be preferable.

A formal account of systems might also be profitable for two further domains of linguistic investigation, namely diachrony and typology. We know, for instance, that unity cardinals like one are one of the diachronic sources of indefinite articles (see, e.g., Heine, 1997; Dryer, 2013b; Kuteva et al., 2019), and also, that demonstrative determiners are one of the diachronic sources of definite articles (see, e.g. Dryer, 2013a; Kuteva et al., 2019). However, as far as I am aware, there has been little investigation into the idea that the presence of one of these items might accelerate or slow down the diachronic change of the other. This, however, might be a possibility, since, for instance in Romance, the definite article appears before the indefinite article (see, e.g., Carlier, 2001: 66f. for French) – which might be an accident, or not.

Similarly, according to the World Atlas of Language Structures (see Dryer, 2013a, b),4 the largest group of languages has no articles at all, while those who have articles tend to have

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3For instance, does the order of application of different constraints (e.g., plural vs. singular first, and then indefinite article vs. definite article) matter, or not? If the number of parameters is small enough, this can simply be tried out, but in case of multiple binary choices, we face a combinatorial explosion.

4Source: https://wals.info/combinations/37A_38A#2/25.5/148.5, consulted on 28/08/2019. Notice that these numbers diverge slightly from what is given in the individual chapters on definite and indefinite articles, namely https://wals.info/chapter/38 and https://wals.info/chapter/37, where the global numbers are higher, but the proportions are similar.
both indefinite and indefinite articles. Among languages having only one type of article, those having only a definite article outnumber those having only an indefinite article roughly 2:1, as is illustrated in table 1.

Once again, the question is whether there is some kind of explainable pattern hidden in these numbers – and there might very well be none. But as of now, we lack the means to investigate such questions coming from diachrony and typology. The aim of this paper is to provide a tool, in order to start to investigate them. The main focus here will be on outlining a way on how to deal with determiner systems in the context of the game of same and different, rather than on confronting it with (diachronic or typological) data.

The remainder of the paper is structured as follows: section 2 introduces the game of same and different, describing both the states and the forms involved. In section 3, this game will be analyzed using a Rational Speech Act model, both in its behavior in the limit, and in contexts of bounded rationality. Section 4 confronts the predictions and assumptions of the model with sample data from classical Latin. Section 5 concludes the paper.

2. The Game of Same and Different

The Game of Same and Different is a signaling game, with in the most general case \( n \) states of the world that a speaker signals, and for which \( m \) different messages can be used. The hearer then tries to map the sent message back to a state of the world. It was originally conceived by Grønn and Szæbø (2012) in order to deal with the choice of definite vs. indefinite articles, and the presence or absence of a novelty effect associated with the indefinite article.

2.1. The Game of Same and Different by Grønn & Szæbø

Grønn and Szæbø (2012) observe that very often, the use of an indefinite article is associated with a novelty effect, as is illustrated in (6).

(6) Richard heard the Beaux-Arts Trio last night and afterwards had a beer . . .
   a. . . . with the pianist.
   b. . . . with a pianist.

The use of the indefinite article in (6b) suggests that Richard had a beer with a pianist who is not one of the members of the Beaux-Arts Trio, whereas the use of the definite article in (6a) precisely suggests that the pianist is the pianist who is a member of the Beaux-Arts Trio. This meaning effect can be seen as the result of a novelty effect associated with the indefinite article.
However, as Grønn and Szæbø (2012) note, this novelty effect is not present everywhere, otherwise, a sentence like (7a) should be fully felicitous under the assumption of a competent speaker, which it is not; though, the more explicit another is appropriate:

(7) Richard heard the Beaux-Arts Trio with its new cellist and its new violinist last night and afterwards had a beer with...
   a. . . ?a cellist.
   b. . . another cellist

They argue that the availability of the another leads to this infelicity, and they develop a formal account of the distribution of the definite article, the indefinite article, and another. Their account is, however, restricted to competition between singular forms, and deals with the question of whether the referent of determiner N is identical to or different from an entity already established in discourse.

Before extending their idea, let us see how this is represented in the framework of a signaling game. We have two states that could be signaled, namely identity and difference (as formalized in (8)); and three forms at our disposal, namely a N, the N, and another N (as illustrated in (9)).

(8) a. identity: \[ \frac{x|P(x)}{z|P(z), z = x} \]
   b. difference: \[ \frac{x|P(x)}{z|P(z), z \neq x} \]

(9) a. \[ a \mapsto \lambda P . \lambda Q . \frac{z|P(z), Q(z)}{x|P(x)} \]
   b. \[ the \mapsto \lambda P . \lambda Q . \frac{z|P(z), Q(z), z = x}{x|P(x)} \]
   c. \[ another \mapsto \lambda P . \lambda Q . \frac{z|P(z), Q(z), z \neq x}{x|P(x)} \]

Obviously, if we want to account for a full determiner system, this basic outline has to be extended, which we will do in section 2.2.

2.2. The Full Game of Same and Different

In order to separate the full framework (applicable in principle to any type of language and number system) from its application to some particular language, I will proceed by considering the very abstract general scheme, and then apply this scheme as an illustration to a language with a singular-plural system.

Generally, we will have to consider two elements: the presupposition and the assertion. I will

The notation in the rest of the paper uses the flat DRT notation by Sauerland (2008a) (where the numerator corresponds to the presupposed content, and the denominator represents the asserted content). For further illustration, the flat (ia) corresponds to the (probably more familiar) box notation (ib):

(i) a. \[ x, y | P(x), Q(y) \]
   b. \[ P(x) \]
   \[ Q(y) \]
start with the presupposition.

The presupposition (and thus, the Common Ground, henceforth CG) could be empty, or there might be some presupposition with respect to a predicate $P$:

\[ \text{(10)} \]
\begin{align*}
a. \quad \text{[empty CG]} &= \bullet \\
\quad \text{non-empty CG} &= \{x \mid P(x)\}
\end{align*}

Here and in what follows, $x$ represents a number-neutral discourse referent; $\bullet$ represents some formula.$^6$

The assertion part is more complicated, since there are more possibilities to consider:

\[ \text{(11)} \]
\begin{align*}
&\text{[existence]} = \frac{\bullet}{z \mid P(z)} \\
&\text{[identity]} = \frac{\bullet}{z \mid P(z), z = x} \\
&\text{[difference]} = \frac{\bullet}{z \mid P(z), z \neq x} \\
&\text{[partitive]} = \frac{\bullet}{z \mid P(z), z \sqsubseteq x} \\
&\text{[superset]} = \frac{\bullet}{z \mid P(z), x \sqsubseteq z}
\end{align*}

While identity and difference are already present in Grønn and Szæbø (2012), the present article also considers partial identity between the presupposition and the assertion, namely partitive and superset, and also considers cases where there is a pure assertion of existence (since an assertion can concern an entity not present in the common ground).

With these basic ingredients in place, we can now consider its application to some language, and combine the different types of presuppositions with the different types of assertion, given the background of the number system of the language.

### 2.2.1. States in the Full Game of Same and Different

Let us assume a language with a singular and a plural. If we specify the number-neutral variables by attributing singular or plural values, we obtain thus 3 different types of presupposition, namely an empty common ground, or a singular or a plural common ground. For the assertion, we have singular and plural varieties of each of the five basic types given in (11), giving us a total of 10 different types of assertion. Theoretically, thus, we could obtain $3 \times 10 = 30$ different combinations in a singular-plural language. In a language with an additional dual, we would obtain $4 \times 15 = 60$ different possibilities.

However, all possibilities are not consistent, and some are redundant. Consider for instance an empty common ground: In this case, we cannot have an identity relation with the assertion, nor a partitive. Similarly, for the identity relation between presupposition and assertion, the number of the presupposition and the assertion need to be identical. Therefore, in a singular-plural language, there are 12 different configurations that are neither redundant nor contradictory:

\[6\] I will dispense in what follows with $\lambda$ notation for semantic representations.
The three-letter descriptive labels in (12) read as follows: the first letter always refers to the common ground, which can be either Empty, Singular, or Plural. The second letter refers to the relation of the assertion with respect to the common ground, and may be New, Identical, Part-of, or Superset-of. The third letter refers to the assertion part, and may be either Singular or Plural.\textsuperscript{7}

To rehearse this, let us consider a few examples. For instance, ENS refers to a configuration where the common ground is empty with respect to the predicate, where there is a singular asserted, and where that singular is new with respect to the common ground. This corresponds to a typical context which would require an indefinite article in a language like English, as illustrated in (13a). PIP refers to a configuration where there is a plural entity in the common ground, and where the assertion concerns a plural entity which is identical to the element in the common ground. This corresponds to a context in which one would use either a demonstrative or a definite article in English (see (13b)). Then, let us consider the PPS case: here, there is a plural in the common ground, the assertion is a singular, and this singular is a part of the plural antecedent. In English, such a configuration seems to require the cardinal one, as is illustrated in (13c). Finally, consider an SNS configuration, where a plural in the common ground, and the asserted singular is new with respect to this plural. In English, another N would be used in such a configuration.

\begin{enumerate}
\item \textbf{ENS} = \frac{\text{\text{-existing} \text{x}}}{\text{\text{x} \text{\in} \text{ \text{X}}} \\
\item \textbf{ENP} = \frac{\text{\text{\exists} \text{x} \text{\in} \text{ \text{X}}} }{\text{\text{\exists} \text{x} \text{\in} \text{ \text{X}}} \\
\item \textbf{SNS} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{SNP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PNS} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PNP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{SIS} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PIP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PPS} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PPP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{SSP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } \\
\item \textbf{PSP} = \frac{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} } }{\text{\text{\text{exists} \text{\in} \text{ \text{X}}} }
\end{enumerate}

The present version of the game of same and different includes every relation between the content of the presupposition and the content of the assertion. Notice, however, that we do not necessarily need to add the superset relation as a primitive to the system, since this could be derived compositionally as a combination of an identity statement (that is, either SIS or PIP) with one of the new statements (that is SNS, SNP, PNS and PNP), which would give us a more fine-grained taxonomy:\textsuperscript{8}

\textsuperscript{7}I assume that there are no empty assertions.

\textsuperscript{8}The present version of the game of same and different includes every relation between the content of the presupposition and the content of the assertion. Notice, however, that we do not necessarily need to add the superset relation as a primitive to the system, since this could be derived compositionally as a combination of an identity statement (that is, either SIS or PIP) with one of the new statements (that is SNS, SNP, PNS and PNP), which would give us a more fine-grained taxonomy:
2.2.2. Forms in the Game of Same and Different

Whereas the states only depended on the number system of the language, the forms to be considered will depend on the language (which is a priori rather easy), and also on the question what is to be taken to be a relevant alternative in the determiner system of the language (which is a more difficult consideration, to which we will have to come back to in section 4).

For the sake of the argument, I will use a language with a singular-plural system (assuming an inclusive plural), assuming that language to have no ‘real’ articles, but nevertheless having a demonstrative, an expression signifying other, and a unity cardinal one. The semantics of these forms is given in (14). The aim is to be close enough to actually existing Latin in order to be able to discuss a choice of issues, without being bogged down by the difficulties (which will be discussed later in section 4).

(i) a. This donkey and (also) another donkey were looking at us. [SIS + SNS = SSP]
b. This donkey and (also) other donkeys were looking at us. [SIS + SNP = SSP]
c. These donkeys and (also) another donkey were looking at us. [PIP + PNS = PSP]
d. These donkeys and (also) other donkeys were looking at us. [PIP + PNP = PSP]

At least the meaning for demonstrative is too simplified – while it certainly has to refer to an entity already in the common ground, there should be some additional accessibility condition to it (see, e.g., Acton, 2014); the meaning as it stands corresponds more or less to what is assumed to be a semantics for a definite determiner. We will come back to this issue in section 4 below.

2.3. Form-Meaning Matrix of the Game

Now that we have made assumptions about the states that a hearer wants to signal, and the linguistic forms to be used to that end, we can fill in a form-meaning matrix to our game. This is done as follows: for each form, we check whether it is compatible with the constraints of the situation. If it is compatible, we enter a 1 in the matrix (meaning thus ‘grammatical’); if it is incompatible, we enter a 0 in the matrix (which means thus ‘ungrammatical’). The result is

(14) a. [bare SG] = \[z | \bar{P}(z), Q(z)\] \[x | \bar{P}(x)\]
b. [dem SG] = \[z | \bar{P}(z), Q(z), z = x\]
c. [one SG] = \[z | \bar{P}(z), Q(z), |P \cap Q| = 1\]
d. [other SG] = \[z | \bar{P}(z), Q(z), z \neq x\]
e. [bare PL] = \[Z | \bar{P}(Z), Q(Z)\]
f. [dem PL] = \[Z | \bar{P}(Z), Q(Z), Z = X\]
g. [sev PL] = \[Z | \bar{P}(Z), Q(Z), |P \cap Q| \geq n\]
h. [other PL] = \[Z | \bar{P}(Z), Q(Z), Z \neq X\]

Since the superset configurations are of a more peripheral interest in this paper, I will tentatively maintain them in the set of states to be signaled.
Table 2: The Form-Meaning Matrix of the Full Game of Same and Different in Widest Scope Contexts

<table>
<thead>
<tr>
<th></th>
<th>bare SG</th>
<th>dem SG</th>
<th>one SG</th>
<th>other SG</th>
<th>bare PL</th>
<th>dem PL</th>
<th>sev PL</th>
<th>other PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENS</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ENP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SNS</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SNP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PNS</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PNP</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PIP</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PPS</td>
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<td>1</td>
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<td>1</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PPP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SSP</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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</tr>
<tr>
<td>PSP</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 makes a somewhat generous assumption on the cardinality restriction of several PL: I have assumed that it will be appropriate if \( n \geq 1 \), in order to preserve the general symmetry between singular and plural, while assuming an inclusive plural. Nothing particular hinges on this assumption; the pragmatic outcome in the limit would be the same if several PL excluded singular instances.

This fact can be illustrated for English with the opposition between the indefinite article and a demonstrative, as illustrated in (i). While the indefinite article shows scopal ambiguity (the familiar specific vs. non-specific distinction), this is not the case for the demonstrative.

(i) a. Every student saw a movie. [✓ every student > a movie; ✓ a movie > every student]
b. Every student saw this movie. [*every student > this movie; ✓ this movie > every student]

The reasoning in Grønn and Szabò (2012) crucially hinges on the fact that in narrow-scope contexts of the, a and another, their respective distribution is no longer the same as in widest-scope contexts.
SIS and PIP). The felicitous use cases for the demonstrative are a strict subset for the grammatical contexts for the bare singular and plural, respectively. The pattern of the distribution of a form being a strict subset of another also holds for the relation between the bare forms (singular and plural) and ‘other’ (singular and plural): whenever the use of other is grammatical, the use of a bare form would also be grammatical; the inverse, however, is not true.

3. The Game of Same in Different in RSA

In order to obtain a behavioral prediction from table 2, we need to apply some kind of pragmatic framework to it. I will use here the Rational Speech Act Model (see, e.g., Goodman and Stuhlmüller, 2013; Franke, 2017; Scontras et al., 2018), even though related models from the iterated response family (though not iterated best response) would yield comparable predictions.

The basic idea in such a framework is that a minimally pragmatic speaker (or Speaker₁) will choose the form to signal anticipating the reaction of a literal hearer. Similarly, a minimally pragmatic hearer (or Hearer₁) will anticipate the behavior of the minimally pragmatic speaker in order to maximize the success of the communication. More generally, a speakerₙ will anticipate a hearerₙ₋₁, and a hearerₙ will anticipate a speakerₙ. The procedure can be stated as in Franke (2017):

(15) a. \( \text{Speaker}_{n+1} = \frac{\exp(\lambda \cdot \text{EU}_S(m, t, \text{Hearer}_n))}{\sum_{m'} \exp(\lambda \cdot \text{EU}_S(m', t, \text{Hearer}_n))} \)

b. \( \text{Hearer}_{n+1} = \frac{\Pr(t) \cdot \text{Speaker}_{n+1}(m|t)}{\sum_{t'} \Pr(t') \cdot \text{Speaker}_{n+1}(m|t')} \)

where \( m, m' \) = linguistic forms sent by the speaker, \( t, t' \) = states of the world, and \( \lambda \) is the softmax-parameter, indicating on how rational the agents will perform.

The Expected Utility of a speaker, \( \text{EU}_S \) is defined as follows:

(16) \( \text{EU}_S(m, t, \text{Hearer}_n) = \log(\text{Hearer}_n(t|m)) + \text{Hearer}_n(t|m) \times c_m \)

This version of the RSA thus assumes that speakers have preferences with respect to the cost of the message they send (the [inverse] cost of a form is expressed in (16) by \( c_m \)), whereas hearers have preferences with respect to the frequency of the states (see the weighting with the probabilities of the states \( t \) in (15b)).

In the setup of the game, I assumed that speakers prefer shorter forms to longer forms, and fewer words to more words. It is quite obvious that the bare forms should be less costly than messages with a demonstrative or other; however, it is less clear if we should generally assume singulars to be less costly than plurals. It turns out that for our purposes, it does not matter if singulars are more or less costly than plurals (at least, as long as the difference is located in a reasonably close range of values); the one thing that does matter for the outcome is that one SG be more costly than the bare SG, and that several PL be more costly than the bare plural --- which do not seem to be very problematic assumptions to make.

Concerning states, table 3 assumes that situations where the item is new or identical are more

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12The reason for this is that most effects on the distributions of the messages in the systems are technically scalar implicatures, which are not sensitive to message weight in RSA. However, we will observe a specialization effect between the bare forms and the cardinal forms, which is technically a manner implicature, and this does depend on differential speaker and hearer preferences.
frequent than situations with partitive and superset configurations. This particular assumption (or more specifically, that the new configuration is more frequent than the partitive configuration) is required, and we will see in section 4 below that this is indeed the case. I have also assumed that singular states are more frequent than plural states, but nothing specific hinges on this assumption — at least, as far as the convergence behavior of the system is concerned.\footnote{Once again, this is due to the fact the RSA does not require differential frequencies of states for cases of scalar implicatures, but only for manner implicatures.}

In what follows, I will assume that the speaker knows precisely the state of the world, and that there are no errors in picking a message. Furthermore, I assume that the hearer has to infer the state based on only the message and a prior on the states, but that there is no further contextual information helping with that inference. Both of these assumptions are questionable, but the one made on the hearer is probably more consequential, and less of an innocent idealization. The issue is the following: a state like SIS has two components: the presupposition and the assertion. The presupposition concerns items that are in the common ground, and it is a not entirely unreasonable assumption that the common ground is indeed common, and shared between speaker and hearer.\footnote{This problem was pointed out to me by Michael Franke (p.c.).} There are certainly cases where an element in the common ground has to be accommodated, but this is not the rule. As it stands, the model assumes that all elements in the common ground have to be accommodated.\footnote{I have tried to quantify the extent of the problem using two Latin texts in PROIEL, namely Caesar’s Gallic Wars and Cicero’s Letters to Atticus, as illustrated in the table below. As expected, the proportion of accommodated DPs varies widely following the text type and assumptions an author/speaker can make with respect to the reader/hearer: Cicero’s letters had a specific addressee, with whom the author shared many background assumptions; Caesar’s history of the Gallic Wars was aimed at the general Roman public of the time.}

3.1. Behavior in the Limit — Convergence

If given sufficient leeway to converge (for instance, by choosing a highly sophisticated speaker of level 10, and a softmax-parameter of 5), this will produce the prediction of behavior as indicated in table 3.

Thus, the RSA model predicts that the use of the demonstrative should become obligatory (which is a scalar implicature), for whatever precise meaning it has (and the assumed meaning above is clearly not specific enough, since it lacks some kind of accessibility condition from the common ground), and provided, it is an alternative in the first place.

The use of the unity cardinal is predicted to specialize for PPS-situations (which is a manner implicature), and this is driven by the differential in cost for the speaker, and the differential in

\begin{table}[h]
\centering
\begin{tabular}{l cc}
\hline
 & Caesar (GW) & Cicero (LA) \\
\hline
# anaphoric & 1034 & 156 \\
# accommodated & 379 & 157 \\
% accommodated & 26.8 & 50.2 \\
\hline
\end{tabular}
\caption{Proportion of anaphoric and accommodated DPs in Caesar’s Gallic Wars and Cicero’s Letters to Atticus.}
\end{table}

Technically, this count has been done as follows: among the list of nouns annotated for information structure in the text, the anaphoric category counts the nouns annotated as “old” or “old_inact” (that is, nouns that have a textual antecedent); the accommodated category counts nouns annotated as “acc_sit” (that is, accessible in the situation) or “acc_inf” (accessible by inference). For a description of these labels, please refer to Haug et al. (2014). This way of counting is unlikely to be the best way to quantify accommodation, and should not be seen as anything better or more than a very rough approximation.
frequency for the hearer (partitive situations being rarer).

Furthermore, the RSA-model accounts for the exclusive use of the plural (which is once again a scalar implicature).

Therefore, if one considers these results from the point of view of grammaticalization, rational use is enough to explain (at least parts of) the grammaticalization of definite articles, since the model predicts it to be used exclusively in cases of identity once it has been established as an alternative in the game of same and different. Indeed, the basic obstacle the demonstrative has to face in order to become a definite article is restrictions on its meaning.

However, rational use as embodied in the present RSA model should block (or at least, slow down) the grammaticalization of a unity cardinal into an indefinite article, since the bare singular is involved in a manner implicature which specializes its use for ENS contexts, and where the unity cardinal is restricted to PPS contexts. Therefore, the grammaticalization of indefinite articles must be due to other factors, which have been tentatively identified in Schaden (to appear) as emphasis (see also Ahern and Clark, 2017 for an application of a similar idea to Jespersen’s cycle).

### 3.2. Bounded Rationality and the Emergence of Articles

The results in table 3 were about what the system would eventually converge to (given rather sophisticated speakers and hearers, or also, given enough time). However, actual humans are probably not (all) as rational and sophisticated when having to face the pressure of communication in real time.

One of the advantages of the RSA model is that it allows us to investigate what happens if we relax the assumptions of high rationality, and take as a base more realistic speakers and hearers (that is, speakers and hearers that are more constrained by real time pressure, and less sophisticated).

In RSA, there are two proxies for rationality and sophistication: First, the depth of counterfac-
tual reasoning: do I merely assume a minimally pragmatic speaker (or hearer), who reacts to a literal hearer (or speaker), or should we assume a more sophisticated pragmatic speaker of level $n$, who reacts to a pragmatic hearer of level $n-1$? In section 3.1, I assumed a speaker of level 10, whereas in psycholinguistics, generally, only the minimally pragmatic speaker of level 1 is assumed. Second, there is the issue of how sensitive a speaker (or a hearer) should be when confronted with small differences, which is expressed with the softmax parameter $\lambda$. If $\lambda$ is set to 0, a speaker will choose a form uniformly at random; with very high values for $\lambda$, a speaker will choose nearly deterministically the form best corresponding to his preferences, even though a second form may be only slightly dispreferred.

Assuming the simplest pragmatic speaker ($S_1$), and $\lambda = 3$, we obtain the prediction in table 4. Here, we no longer obtain categorial predictions (that is, in this context, only use form $x$), but probabilities of use. There are two striking facts that deserve discussion in table 4: first, even with a relatively unsophisticated speaker, the demonstrative singular is predicted to be used in 96% of the instances of SIS contexts, and its main competitor in this context is the demonstrative plural with 3.5%. In the PIP context, the demonstrative plural is predicted to appear in over 99% of cases.

This strong picture of specialization for identity contexts already at low degrees of sophistication contrasts with the low degree of specialization we obtain for ENS and ENP contexts. Here, the bare forms are predicted to appear very slightly more frequently than 50%, and the unity cardinal (or the several form) are not far behind (at 44% and 48%, respectively). This is no artefact of the settings for $\lambda$ and the degree of recursion employed for table 4; we can plot the predicted difference between the probability of the marked form (that is, the demonstrative or the unity cardinal) and the probability of the unmarked form (that is, the bare form) for the SIS and ENS contexts, respectively, for different values of $\lambda$ and different depths of recursion, as is illustrated in figure 1.

In table 4, if a line hits either 1 or -1, that means that the system has converged — either toward the marked form, if the line is at 1, or to the unmarked form, if the line is at -1. The reason is the following: 1 or -1 can only be reached if one of the two forms has reached a probability of 1, and the other has a probability of 0. Each line represents a degree of recursion (where the

<table>
<thead>
<tr>
<th></th>
<th>bare</th>
<th>dem</th>
<th>one</th>
<th>other</th>
<th>bare</th>
<th>dem</th>
<th>several</th>
<th>other</th>
</tr>
</thead>
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<td>0.85231</td>
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<td>0.00000</td>
<td>0.00195</td>
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<td>0.00000</td>
<td>0.00000</td>
<td>0.02876</td>
<td>0.00000</td>
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<td>0.94387</td>
</tr>
<tr>
<td>SIS</td>
<td>0.00127</td>
<td>0.96180</td>
<td>0.00112</td>
<td>0.00000</td>
<td>0.00006</td>
<td>0.03567</td>
<td>0.00006</td>
<td>0.00000</td>
</tr>
<tr>
<td>PIP</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00180</td>
<td>0.99647</td>
<td>0.00171</td>
<td>0.00000</td>
</tr>
<tr>
<td>PPS</td>
<td>0.50349</td>
<td>0.00000</td>
<td>0.44655</td>
<td>0.00000</td>
<td>0.02560</td>
<td>0.00000</td>
<td>0.02435</td>
<td>0.00000</td>
</tr>
<tr>
<td>PPP</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.51249</td>
<td>0.00000</td>
<td>0.48750</td>
<td>0.00000</td>
</tr>
<tr>
<td>SSP</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.51249</td>
<td>0.00000</td>
<td>0.48750</td>
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<tr>
<td>PSP</td>
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<td>0.00000</td>
<td>0.51249</td>
<td>0.00000</td>
<td>0.48750</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

Table 4: Behavior of Determiner System given the Simplest Pragmatic Speaker ($S_1$), with $\lambda=3$
Figure 1: Difference between Marked and Unmarked Form for Different Levels of Sophistication

The line closest to the center represents S_1, and lines further out speakers S_2 to S_{10}, with \lambda going from 0 to 10, as we move on the x-axis. As can be seen, the convergence in the ENS context to the bare form is much slower than the convergence toward the demonstrative in the SIS context.

So, let us sum up the result of this figure: the less rational a speaker, the more instances of one there will be for the ENS scenario, but the less rational a speaker, the fewer instances of the demonstrative there will be for the SIS scenario. However, the speed of convergence for the demonstrative outpaces by far the speed of convergence against the unity cardinal. Maybe this difference in speed gives the unity cardinal a fighting chance to be pushed by other factors, but it is clearly to early to draw firm conclusions.

One potential problem we should be aware of at this point is that the difference in speed might be an artefact of the (RSA) model used here, and not reflect any cognitively real difference between the two processes. The issue is the following: RSA models predict a fast convergence in cases of scalar implicature, whereas the derivation of manner implicatures is a slower and more involved process (see figure 4). At this point, it is not certain that we can simply assume that this is a reflection of an underlying greater cognitive cost of processing manner implicatures vs. scalar implicatures. It would be possible that in an RSA model, any tentative of fitting the speed of a diachronic development that is based on a scalar implicature vastly overestimates the speed of a diachronic development based on a manner implicature. In the end, this is an empirical question, which cannot be answered in the current paper.

However, I would like to stress that, while the difference in speed might thus be an artefact, the difference in direction is certainly not, and suggests a major difference in the diachronic evolution of definite and indefinite articles.

4. A Brief Look at (Classical) Latin

Up to now, my basic concern was to present the outline of the system, and to determine its predictions. To this end, I have considered a language that was basically a sanitized version of Latin. But what about real Latin? Do the assumptions made to derive the predictions hold up to reality? I will briefly consider some of the necessities in order to arrive at the predictions.
Let me briefly recapitulate the basic facts we would like to derive: the Latin demonstrative *ille* eventually became the definite article in most current Romance languages, and the Latin unity cardinal *unus* eventually became the indefinite article in current Romance languages.

In order to evaluate the predictions we get from the RSA model, we need a corpus annotated syntactically, and also annotated for the game of same and different. Such a corpus does not exist, but we can derive such a corpus from the annotations in PROIEL (see Haug and Jøndal, 2008; Haug et al., 2014), which provides us with 3 Latin texts that have been fully annotated for information structure. This gives us a very limited number of texts, and whose annotation has to be transformed, but it gives us a useful starting point to check some of the assumptions.

In order to derive the model, a crucial ingredient was the assumption that partitive contexts (notably PPS and PPP) are less frequent than *new* contexts (namely ENS and ENP); the general question underlying this is the distribution of the states of the game, as far as NPs (or DPs) are concerned. As it turns out, the distributions vary slightly, but in all cases, SIS is the most frequent state, with ENS second or third, and PPS and PPP further down the line. The assumption of the model is thus validated. The general distributions can be illustrated for Caesar and Cicero in figure 2, which shows a count of NPs/DPs which contain a noun (be it common or a proper noun). This count thus excludes strictly pronominal anaphora.

While both of these texts have been written in the same year, by male members of the Roman senatorial aristocracy, they belong to rather different *genres* (political commentary or historiography vs. personal letter), which may in part influence the distribution of the states.

Let us now come to the predictions with respect to the forms. The model predicts that the demonstrative should be used for all instances of the SIS and PIP states. This clearly is an incorrect prediction, since the immense majority of cases of these states, bare forms are used (as is illustrated in table 5 for Caesar’s *Gallic Wars*; the same pattern also appears in Cicero).

So, what are the reasons for this divergence between the predictions of the model, and actually occurring classical Latin? First, the model assumed that there is one demonstrative determiner

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16The fully annotated texts are Caesar’s *Gallic Wars*, Cicero’s *Letters to Atticus*, and the *Pilgrimage of Egeria*. The gospels from Saint Jerome’s *Vulgate* are partially annotated.

17Notice the presence of a NA column in this table. This means that the annotators of the PROIEL corpus were not able to attribute an information status to the noun.
in the language. However, classical Latin (just like contemporary English) has several of those, namely *hic*, *ille*, *ipse* and *is*, and there is no single obvious candidate for the game of same and different. The same is true for *other*: instead of having one form to express such a meaning, Latin has two forms, namely *alter* and *alius*.

The best explanation is probably that — at least in the mid-first century BC — there was no demonstrative present as an alternative in the game of same and different. One possible argument for this is the difference in the uses of the adnominal determiners in Caesar and Cicero. While *ille* is the most frequent demonstrative in adnominal use in Cicero, it does not appear once in adnominal position in Caesar’s *Gallic Wars*. This is illustrated in figure 3. The point is that we would not expect a strong divergence in the frequencies of use if these were really strongly grammatically constrained items. Another possible argument against introducing some demonstrative as an alternative into the game of same and different is that its semantics does not necessarily fit. The problem is the following: while a demonstrative definitely requires its referent to be localizable in the common ground, it normally comes with further accessibility conditions (for instance, on distance with respect to the speaker; see, e.g., Acton, 2014: 63), especially when there are several demonstratives in a language.

And if we remove the demonstrative forms (singular and plural) from the form-meaning matrix,
the predicted outcome of convergence is that the bare singular is used deterministically for both ENS and SIS contexts, and also that the bare plural is used deterministically for both ENP and PIP contexts, as is shown in table 6.

Similarly, the question is whether we should assume that alter and alius are a part of the game, since the states of SNS, SNP, and PNP are more often expressed by the bare forms than by the marked forms with alius or alter; or whether we should assume that unus or multus (the equivalent of ‘several’) are alternatives at this time, since unus fails to make a dent into the share of the bare singular in the PPS context, and multus is not used in PPP contexts.

If we further remove the unity cardinal and the equivalent of several as forms from the game of same and different, the prediction is that the bare singular is used deterministically for PPS contexts, and the bare plural for PPP contexts. Further removing other from the forms will result in a situation where the bare singular is used for all singular states, and the bare plural for all plural states. This seems to be the best fit prediction for table 5.

This, however, raises the question how we could determine a priori and in a principled way which kind of message has to be considered at a given time in a given language, and what causes some form to become an alternative in the game. It seems clear in any case that one will not be able to rely on frequency alone in order to determine this fact, since (an)other in English has a rather low frequency, and is still required as an alternative for the game of same and different (as has been argued, convincingly, by Gronn and Szabó, 2012). Another criterion could be semantic: a form is an alternative in the game of same and different if its semantics allows for it, and it has to represent exactly one or more of the states in example (12).

Summing up, the basic assumptions on the frequencies of states seem to be sound (if we can extrapolate from these two Latin texts), while the crucial issues (which are much harder to control) seem to be i) what criteria determine the availability of a given form as an alternative in the game of same and different; and ii) what processes could cause a form that was previously not an alternative in the game to become an alternative.
5. Conclusions and Perspectives

In this paper, I have tried to show that (in principle arbitrarily complex) linguistic systems can be modeled in an RSA model (or other versions of iterated response models), and the specific example chosen to illustrate this were determiner systems, based on the game of same and different, generalized from Grønn and Szæbø (2012). Such models can be of great use for investigating multiple, interacting — and possibly conflicting — constraints.

One obvious application for such a model is the investigation of the diachronic development of determiner systems. Potentially, an RSA model can provide quantified predictions of frequencies, which can be checked against texts in corpora. In the present paper, I have only provided a basic check against the distribution of (proto-)determiners in Latin, based on the Latin texts in the PROIEL corpus. The main problem of deploying the game of same and difference on a larger scale, and to be of use in tracking the diachronic development of determiner systems is that this requires corpora that are annotated for both syntax and information structure, and in order to be fully comparable, ideally in a format that is compatible with PROIEL. As far as I am aware, such corpora do not exist as of now, and even for Latin, the number of texts in PROIEL is very small (as compared to the number of surviving texts). Since reasoning on systems requires an estimation of many different parameters (speaker preferences with respect to every form; hearer assumptions with respect to the frequencies of every state), and that there seems to be considerable variation among existing sources (see figures 2 and 3), we would ideally like to have as many texts as possible.

Figure 4: Convergence of Manner Implicature for Speaker 1 (top left) to Speaker 4 (bottom right)

There is possibly one technical (or theoretical) obstacle which might limit the applicability of RSA models (and also of Iterated Quantal Response models) in their current form as formal-
ized in Franke (2017), and this concerns the differing resource requirements these frameworks predict for scalar vs. manner implicatures. Scalar implicatures in these frameworks converge with considerably less sophisticated agents than manner implicatures (as is illustrated in figure 4, a manner implicature only really starts converging with Speaker3; a scalar implicature already converges more strongly with Speaker1). While comparative rates of change do not matter as long as we only consider the behavior in the limit, it might turn out to be important if we want to predict language change. If manner implicatures are really cognitively more demanding than scalar implicatures, they should also take longer to show an effect in diachrony. However, I am not aware of any research into the comparative cognitive load associated with different types of implicatures, and the differential might turn out to be an artefact of this type of iterated response frameworks, rather than a fact about language processing.

References


Abstract. This article discusses short-comings of commitment space semantics as introduced in Krifka (2015) with respect to assertions, confirmations, and contradictions. It proposes to transform commitment space semantics to a modal logical framework which allows not only for an elegant solution of these issues, but also for the accommodation of other phenomena central to any comprehensive model of human communication (this really being the main point behind going modal).

Keywords: assertion, confirmation, contradiction, commitment space semantics, modal logic, speech acts

1. Introduction

Commitment Space Semantics is a formal model of speech acts and was proposed in Krifka (2015). It is designed to model the dynamic effects of speech acts in conversation, i.e., how speech acts shape conversation. In his proposal, Krifka considers assertions and reactions to assertions, particularly confirmations with bare yes and contradictions with bare no (among others). As will be argued here, his proposal is inadequate and therefore a refinement is called for: contrary to Krifka (2015) the essential effect of an assertion comes about only if the relevant interlocutors share the commitment of the assertion’s author, and responses to assertions are a means to promote or block this effect thus preceding it. However, instead of providing such a refinement in commitment space semantics itself\(^3\), this paper proposes to go modal straight away. The reason for this is mainly because conversing is not only a matter of expressing commitments: knowledge, beliefs, intentions, preferences, and strategies (among possibly other things) also play a key role in our daily communicative life, and these notions all have found analyses in modal logical frameworks (for an overview of such frameworks see for instance van Benthem (2011)). Thus, going modal allows for accommodating many phenomena relevant for a comprehensive model of human communication.

The paper is structured as follows. Section 2 introduces commitment space semantics as presented in Krifka (2015) and contains the critique. In section 3 the new framework will be presented and it will be shown how to model assertions and responses to assertions more accurately.\(^4\) Section 4 quickly introduces a simple epistemic extension of the framework presented in section 3. Section 5 concludes.

2. Commitment Space Semantics

In Krifka (2015) commitment space semantics has been introduced. It is a formal model for studying the dynamic effects of speech acts in conversation. By this is meant a formal model for studying how speech acts shape conversation. Conceptually, the model is based on two

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\(^1\) I gratefully acknowledge support by the European Research Council, ERC-2017-ADG 787929 SPAGAD, Speech Acts in Grammar and Discourse. Special thanks to Stephanie Rotter for proofreading. Remaining errors are mine.

\(^2\) Logicians shouldn’t take the title too serious.

\(^3\) June 10, 2020: Such a refinement has been worked out by and large.

\(^4\) The framework does not model all aspects of assertions and responses to them. Consequently, it is only more accurate than Krifka’s proposal.
points. First, conversation has to do primarily with commitments. Secondly, speech acts shape conversation by changing commitments of interlocutors. In the following, we will focus on the formal model and neglect the philosophical and conceptual underpinnings of it. We will now serve an introduction of commitment space semantics, followed by a discussion of the analysis of assertion, confirmation with bare yes, and contradiction with bare no respectively.

2.1. Commitment space semantics

The basic unit of commitment space semantics are commitment states $c$. These are sets of propositions. A commitment state $c$ is intended to represent the shared public commitments of the interlocutors (Krifka (2015): 328-329). In fact, they are treated as common grounds (Krifka (2015): 343). Speech acts $A$ are identified as functions mapping a commitment state $c$ and a proposition $\phi$ to a new commitment state $c' = c \cup \{\phi\}$ (Krifka (2015): 329). The basics in place, we can consider the object that gives the model its name: the commitment space. A commitment space $C$ is a set of commitment states satisfying two conditions: first, $\cap C \neq \varnothing$, and second, $\cap C \in C$ (Krifka (2015): 329). A commitment space $C$ is interpreted as adding a temporal dimension: $C$ is supposed to represent the current shared public commitments of a conversation ($\cap C$) plus the future developments (any $c \in C$ with $c \neq \cap C$) (Krifka (2015): 329). The two conditions ensure that there is a unique non-empty set of shared public commitments, so that we indeed can speak of the current shared public commitments or the current common ground. This allows then to model the future developments of the current common ground in conversation. The conversational effects of speech acts are also modeled on the level of commitment spaces: $C + A = \{c \in C : c \cap C \cup \{\phi\} \subseteq c\}$ for updating a commitment space with a speech act (Krifka (2015): 329). This means: the dynamic effect of a speech act $A$ with content $\phi$ (a proposition) on the commitment space $C$ consists in taking all commitment states $c$ in $C$ such that they contain $\phi$. The rest you throw away. Below an illustration:

![Commitment Space Diagram](image)

Figure 1: The least element of the space is denoted by $\cap C$. $+\phi = \cap C \cup \{\phi\}$ and similarly for $+\psi$. The purple square indicates the new commitment space after updating with $\phi$, whereas the black square represents the original space.

With this in place, we are prepared for the discussion of assertions, confirmations, and contradictions in Krifka (2015).

2.2. Assertion, confirmation, and contradiction in Krifka (2015)

We will proceed as follows: we start with the formal analysis of assertions. We then consider confirmations with bare yes. Last, we do the same for contradictions with bare no.
Krifka assumes that a speaker $S$ in asserting $\phi$ does two things: first, $S$ expresses a commitment to the truth of $\phi$ (again, this is a proposition), formally written as $S \vdash \phi$, and second, $S$ intends that $S$’s addressee accepts $\phi$, thereby making $\phi$ common ground (Krifka (2015): 332-333).

Formally, Krifka sees the first part of an assertion to be an update of a commitment space $C$ by a speech act $\mathcal{A}_{S \vdash \phi}$, and the second part by another update of the commitment space $C + \mathcal{A}_{S \vdash \phi}$ with $\mathcal{A}_{S \vdash \phi}$. Importantly, though, it is said that the second update can be cancelled (Krifka (2015): 332-333), meaning it doesn’t have to occur.\(^5\)

Confirmations with yes are treated as reassertions of prior content (Krifka (2015): 334). So for instance, if speaker $S$ asserted $\phi$ and speaker $S'$ responses with yes, i.e., confirms $S$’s claim, then $S'$ in fact asserts $\phi$ too. Formally: let $C'$ be the commitment space after $S$’s assertion of $\phi$ including its essential effect. Then, $C' + \mathcal{A}_{S' \vdash \phi}$ represents the confirmation of $\phi$ with yes by $S'$. Or as a sequence of updates:

$$= C'$$

$$C + \mathcal{A}_{S_1 \vdash \phi} + \mathcal{A}_{\phi}$$

$$\text{assertion by } S_1 \text{ plus grounding of } \phi$$

$$+ \mathcal{A}_{S_2 \vdash \phi}$$

$$\text{confirmation by } S_2$$

(Krifka (2015): 334)

Contradictions with no are similar to their counterparts. According to Krifka, they consist of asserting the contrary, hence in contradicting $\phi$ $S$ asserts $\neg \phi$ (see Krifka (2015): 334). Formally, they are more complex than the above suggests. This has to do with Krifka including an extra step: a retraction.\(^6\) The reason for this being that he treats a contradiction to appear after a successful assertion, by which is meant an assertion that brought about its essential effect (grounding of its content). So, formally then, Krifka proposes the following:

$$\text{Retraction}$$

$$\frac{}{\text{Assertion of } S_1 \text{ plus grounding of } \phi}$$

$$\frac{}{\frac{C + \mathcal{A}_{S_1 \vdash \phi} + \mathcal{A}_{\phi}}{= \cap \{ C \cup \{ S_1 \vdash \phi \} \}}$$

$$\text{Assertion by } S_2$$

$$\frac{\text{Retraction}}{= \cap \{ C \cup \{ S_2 \vdash \neg \phi \} \}}$$

$$+ \mathcal{A}_{S_2 \vdash \neg \phi}$$

(Krifka (2015): 334)

Retraction undoes the update preceding it (see Krifka (2015): 331).

2.3. Conversing is more interactive

We will now assess Krifka’s proposals starting with confirmations, followed by contradictions, and ending with assertions.

As we saw above, confirming for Krifka boils down to reasserting a proposition. Importantly, on Krifka’s account such happens after the essential effect of an assertion has come about. Here

\(^5\)In fact, Krifka argues that the second update, which is what is commonly called the essential effect of an assertion comes about via implicature. The argumentation below will shed doubts on this.

\(^6\)According to Krifka (2015): 335 retraction is not a feature of the semantics of no itself, but is triggered whenever necessary for maintaining a blatantly coherent common ground (for the latter see Krifka (2015): 329), which we ignored since it is of no interest to us.)
again the sequence of updates:

\[ C + A_{S_1} \land \phi + A_{S_2} \land \phi \]

Formally speaking the confirmation makes common ground that the addressee, here \( S_2 \), commits to the truth of the proposition, here \( \phi \), too. Conceptually though, there is an issue with the sequencing. We have prior to this commitment that \( \phi \) itself becomes common ground, for it becomes an element of the least commitment state of that commitment space. The intended meaning of this is that all conversationalists share a public commitment to that proposition, thus making the confirmation by \( S_2 \) redundant.\(^7\) In fact, other researcher on assertions and reactions to assertions argue that confirmations must precede the grounding of the content of the assertion (see for instance Farkas and Bruce (2010): 82, 92). Having confirmations preceding the essential effect of an assertion makes them conceptually non-redundant.

Contradictions, like confirmations, are treated as a sequence of updates:

\[ C + A_{S_1} \land \phi + A_{\neg \phi} + A_{S_2} \land \neg \phi \]

Again, we see that grounding the content of an assertion precedes the act of contradiction. This is problematic for at least two reasons. First, according to Krifka, grounding comes about as a conversational implicature (see below). This raises the very issue of why a contradiction then does not act as a cancelling-operation. Secondly, it makes contradictions look like revisions, and in fact they are modeled as such in Krifka (2015). However, revising one’s stance on a matter is in general a different matter from contradicting someone else on a matter. The latter does not have to involve any revision. So, Krifka’s formal proposal is not a good take on contradictions in general (and ones with bare \textit{no} in particular). And this is precisely because he takes them to happen after the essential effect of an assertion came about which makes it necessary to involve a retraction (a kind of revision). Having contradictions blocking the essential effect of an assertion and thus potentially preceding it is the way to go (see also Farkas and Bruce (2010): 82, Incurvati and Schlöder (2017): 746 among others again).

Let us now turn to assertions. We have already touched upon the claim that grounding the content of an assertion is a conversational implicature. The above suggests that this is unlikely. Instead, grounding seems dependent on the presence of specific reactions. We will now take a closer look at this.

Krifka argues that the intention to make the addressee believe the content of one’s proposition is a conversational implicature on the bases of cases such as the ones below (cf. Krifka (2015): 332):

1. Believe it or not, I won the race.
2. I don’t care whether you believe me, but I won the race.

He then concludes that this is true also of the intention of making the addressee accept the proposition. Again, this is argued to follow from the cases above (Krifka (2015): 333). However, on a commitment-based account, acceptance is only reasonably understood as a matter of

\(^7\)Someone may object: “Well, but \( S_2 \) commits to the truth of \( \phi \) in one case and to \( \phi \) in the other. These are different things.” Usually, propositions are seen as things either true or false. So committing to them seems to make sense only when committing to them being true or false. Since committing to the falsity of \( \phi \) is the same as committing to the truth of \( \neg \phi \) we can conclude that in \( \phi \) being common ground, everyone commits to its truth, and not to its falsity.
commitment. Clearly, the above cases are not about commitments. So, the argumentation falls short.\(^8\)

Nevertheless, it is worth entertaining the thought that grounding comes about by means of a conversational implicature for little longer. What are the consequences of that thought? First, if the essential effect of an assertion – grounding its content – is a matter of conversational implicature, this means that it will come about whenever no one cancels it. This is what we have in Stalnaker (1999) as an requirement. Second, it follows that acceptance does not have to be displayed. In the following, we will see that these consequences do not hold and so the proposal offered by Krifka cannot hold either.

Conversation analysis provides empirical evidence against Krifka’s account. To this end we will consider some general insights from the field as well as an example. We follow here the presentation in Sidnell (2010).

Conversation analysis found that conversation is organized by a couple of mechanisms, among which are so-called preferences. This term is used here not to describe psychological states, but to describe orderings on reaction choices which are institutionalized, i.e., orderings that are part of conversing (cf. Sidnell (2010): 77). In general: a response that promotes the achievement of whatever it is the conversational participants are trying to undertake is preferred (cf. Sidnell (2010): 81, 90-91).

Another important insight of conversation analysis is the import of delay in rejections. Rejections come in a bunch of ways, but a common pattern observed is that they come with a delay. One kind of delay consists in the rejection being preceded by other material. Another kind of delay is silence between turns (cf. Sidnell (2010): 78). This already makes clear that silence is not a good indicator of agreement.

Last but not least, assertions and assessments display a preference for aligning responses, hence for agreements (cf. Sidnell (2010): 85).

The following example illustrates these findings nicely. It is taken from Sidnell (2010): 2.

Context: Ann and Jeff are married. They had two friends with their child visiting who stayed overnight, for breakfast and into the early afternoon. After saying goodbye, the couple returns to their house and the following happens:

(1) Visit – FN
01 Ann: That was fun,
02 (0.4)
03 Jeff: mm
04 Ann: ish.

What is going on here? In line 01 we have a positive assessment of the event by Ann. Note that this is an assertion: Ann commits herself to the truth of the proposition that the stay by their friends with their child was fun. Also, she intends Jeff to agree on this as the rest of the conversation makes clear. Moreover, at that moment of the conversation Ann reaches a point

\(^8\)Of course, one might be able to construe cases like the above ones addressing commitments. We will not consider this possibility here.
where she can finalize her turn and she does so – at least from the perspective of that very moment of the conversation. Now, it is supposedly Jeff’s turn, for Ann started an assessment and she cannot conclude such without Jeff’s contribution. But, silence follows (line 02 with 0.4 seconds of silence). This is an inter-turn gap. In line 03, Jeff finally response “mm” which can be taken to signal agreement. Importantly though, line 04 makes clear that Ann does not take Jeff to agree with her assessment, because she initiates a repair and downgrades her assessment by adding “ish”. This is because she takes Jeff to not agree with her on the matter which is presumably because of the delay of Jeff’s response, which is as we said earlier a common strategy to express disagreement. This suggests then to Ann that Jeff is in fact not aligning with her view of things and thus rejecting it. This then leads her to adjust her initial claim so that Jeff can align with her (see Sidnell (2010): 2-4 for the description of that case).

Thus: first, silence is not a means for signaling agreement in general. Second, people are seeking for positive responses on such occasions in general; hence, third, they are not satisfied with the absence of negative responses in general. All this goes against Krifka’s position, for according to that people are satisfied with the absence of negative responses on such occasions and silence is a way to positively assess assertions.

Another line of research shading doubt on Krifka’s account is that of Herbert Clark and his colleagues. Without going into an extensive discussion of Clark’s account we want to note the following: in Clark (1996) it is argued on empirical grounds for a hierarchical architecture of human communication. This architecture consists of four levels (cf. Clark (1996): 149-150):

1. Level 1: Executing behavior and attending
2. Level 2: Presenting and identifying
3. Level 3: Signaling and understanding
4. Level 4: Projecting and considering

The issue we are considering here is situated on level 4. Importantly, Clark argues that any communicative action needs grounding on all levels (Clark (1996): 221ff). Furthermore, he argues that such is achieved by providing positive evidence that the action underway was successful and that conversationalists are looking for such evidence in conversing (cf. Clark (1996): 222, 226; see also Clark and Schaeffer (1989) making this point already for level 3 and lower). On level 4 this means that speaker S is looking for acceptance of S’s intention. And it is for the addressee to either accept or reject that intention upon uptake. It is not for the addressee to simply not reject it or do nothing. Again, this is contrary to Krifka’s position. Therefore, we find that the essential effect of an assertion is in need of a reaction by the addressee and in particular a positive one.

In sum, we find that assertions demand positive assessments before grounding can occur. Otherwise, no grounding takes place. Confirmations and contradictions are means to react to assertions and either promote the essential effect of an assertion or block it. In the following section, we will introduce a formalism that allows us to model assertions in a way consistent with our

9In general, because some conversational practices deviate from the norm in some way, e.g. reacting to compliments; see Sidnell (2010) chapter 5. In any case, the argument against Krifka (2015) stays untouched.

10The reader is invited to consult Clark (1996).
conclusion. It will make sense of responses to assertions and will treat grounding (at level 4) as a function of the assertion and the reaction to it. What the formalism will not deliver is a formal take on the proposal nature of assertions, i.e., we will not be able to model the intentions of the author of an assertion to make the assertion’s content common ground. This is not a short-coming over Krifka (2015) for there it is not modeled either. We will also not attempt to model grounding on levels lower than level 4. Overall, then, the proposal in the next section is a real improvement over the account offered in Krifka (2015) with respect to assertions and responses to assertions.

3. Modalizing Commitment Space Semantics

In this section we will introduce modal commitment space semantics which takes commitment space semantics and transforms it into a modal logical framework. We will serve the motivation first. Then, we will proceed classical: we introduce the language, the frames, and finally the models. Last, we cast an analysis of assertion and responses to assertion in the new framework and show that it fits the bill of the criticism.

3.1. Motivation

The issues addressed so far are not about the architecture of commitment space semantics, so why proposing to move to another architecture? The reason is methodological: even though it seems possible that commitment space semantics in its current state can account for the criticism put forward here\textsuperscript{11}, moving to a proper modal logical setting brings advantages: we can readily accommodate many other phenomena which are of importance to human communication. This is not to say, that commitment space semantics cannot accommodate phenomena such as knowledge or belief, but this is more complicated. As we will see, transforming commitment space semantics into a modal logical framework is not hard at all (when giving up on a few formalities). Moreover, dynamic modal logics can account for conversational dynamics by the same means they account for other dynamic processes (for an overview see van Benthem (2011)) which provides us with a lean formalism.

3.2. Modal language, frames, and models

**Definition 1** (Modal language). Given a set of proposition letters $\Phi$ and a set of agents $\mathcal{A}$ (which we fix for specific applications), our modal language $\mathcal{L}$ is given by the following inductive syntax:

$$\phi ::= p \mid \neg \phi \mid \phi \land \phi \mid C_a \phi, \text{ where } a \in \mathcal{A}$$

For simplicity we will take $\mathcal{A}$ to be finite in the following.\textsuperscript{12}

**Definition 2** (Commitment frame). Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. A commitment frame is a tuple $(W, \{\Sigma^a_w : a \in \mathcal{A}, w \in W\}, \{R_a : a \in \mathcal{A}\})$, where $W$ is a non-empty set of worlds, for each $a \in \mathcal{A}$ and $w \in W$, $\Sigma^a_w$ is a set of formulas $\phi$ from $\mathcal{L}$. We call $\Sigma^a_w$ the commitment set of $a$ in $w$. Last, for each $a \in \mathcal{A}$, $R_a$ is a binary accessibility relation on $W$. We set: $wR_aw$ if and only if $\Sigma^a_w \subseteq \Sigma^a_w$.

\textsuperscript{11}June 10, 2020: In fact, the proposal made below seems to work for commitment space semantics too.

\textsuperscript{12}The definitions below can be easily adjusted to fit the general case with $\mathcal{A}$ finite or denumerable. However, for exposition the finite case is more suited and is anyway of more interest to our specific applications.
We define frames in such a way because in commitment space semantics commitment states are seen as representing the shared public commitments of conversationalists. Obviously, these are a function of the individual commitments of the participants, so we take the latter as starting point. Making commitments a matter of frames is a contingent choice, however, it resembles the architecture of commitment space semantics more closely. In a sense, what we did here is taking commitment states and glue them to points which we related with lines. Last, the accessibility relations are reflexive not because we want to claim that commitments are veridical (like knowledge), but because the commitments of an agent in a world depend on the commitment set associated with that world.

**Definition 3** (Commitment model). A commitment model \( M \) is a tuple \((\mathcal{F}, V)\) consisting of a commitment frame \( \mathcal{F} \) and a valuation function \( V \), with \( V : \Phi \to \mathcal{P}(W) \) (\( \mathcal{P}(W) \) denotes the powerset of \( W \)).

With the models in place, we can turn to the semantics.

**Definition 4** (Semantics).

1. \( M, w \models p \) iff \( w \in V(p) \)
2. \( M, w \not\models \phi \) iff not \( M, w \models \phi \)
3. \( M, w \models \phi \land \psi \) iff \( M, w \models \phi \) and \( M, w \models \psi \)
4. \( M, w \models C_a \phi \) iff for all \( v \in W \), \( wR_a v \) implies \( \phi \in \Sigma_v^a \)

Clauses 1 to 3 are standard and do not need any further explanation. Regarding clause 4, we treat commitments as universal modalities.

Having the basics in place, we can next consider how to model assertion and responses to assertions.

3.3. Assertion and responses to assertion in modal commitment space semantics

Above we said (following Krifka (2015) among others) that in asserting \( \phi \) a speaker \( S \) does the following: first \( S \) publicizes a commitment to \( \phi \), and second, \( S \) proposes to make \( \phi \) common ground. The latter we argued is a function of the addressee’s public opinion on \( \phi \): if the addressee also publicly commits to \( \phi \), then \( \phi \) eventually will become common ground, otherwise \( \phi \) will not become common ground.

Assertions will be modeled similar as in Krifka (2015). They involve an update. However, unlike in Krifka (2015), we will not treat the second effect of an assertion as an update. Instead, it will come about as a global property of frames that derives from the actual individual commitments of interlocutors. To this end, we further complicate our formal architecture.

**Definition 5** (Agent indexed commitment frame). Let \( \mathcal{L} \) be a language based on the set of agents \( \mathcal{A} \). Let \( a_1, \ldots, a_n \) be an enumeration of \( \mathcal{A} \). An agent indexed commitment frame is a tuple \((\mathcal{F}, a_i)\) where \( \mathcal{F} \) is based on \( \mathcal{L} \).

**Notation.** An agent indexed commitment frame can also be denoted by \( \mathcal{F}_{a_i} \).

**Definition 6** (Agent indexed commitment model). Let \( \mathcal{L} \) be a language based on the set of agents \( \mathcal{A} \). Let \( a_1, \ldots, a_n \) be an enumeration of \( \mathcal{A} \). An agent indexed commitment model is a
An agent indexed commitment model can also be denoted by $\mathfrak{M}_a$.

**Definition 7** (Discourse model). Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $a_1, \ldots, a_n$ be an enumeration of $\mathcal{A}$. A discourse model $\mathfrak{D}$ is an $n$-tuple $(\mathfrak{M}_{a_1}, \ldots, \mathfrak{M}_{a_n})$ of agent indexed commitment models based on $\mathcal{L}$.

**Convention.** For modelling conversation we will assume that at the beginning of the conversation, we have a discourse model $\mathfrak{D}$ with the following property: for $i, j \leq n$ and $i \neq j$: $\mathfrak{M}_{a_i} = ((\mathfrak{F}, a_i), V)$ and $\mathfrak{M}_{a_j} = ((\mathfrak{F}, a_j), V)$. So, we will be assuming that the individual agent indexed commitment models are the same for simplification.

We install this convention as a means of simplification. It gives us that conversationalists conceive the same possible outcomes of a conversation. This is an idealization since people seem not to do so in general. Importantly, though, nothing hinges on this convention – it only makes exposition easier.

Before turning to the definition of an update-operator, that we will use for modelling the first effect of assertions and the like, we will provide definitions of actual commitments and common ground.

**Notation.** Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $a_1, \ldots, a_n$ be an enumeration of $\mathcal{A}$. By $a_i^{-1}$ we denote the agent that has been assigned the number $i$ by the enumeration.

**Definition 8** (Actual commitments of agent $a$). Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $\mathfrak{M}_{a_i}$ with domain $W$ be an agent indexed commitment model based on $\mathcal{L}$. Let $\phi$ be a formula from $\mathcal{L}$. Let $a_i^{-1} = a$. Then, we say that $\phi$ is an actual commitment of $a$ iff $\phi \in \{ \psi : \psi \in \Sigma_a^w \text{ for each } w \in W \}$.

**Definition 9** (Common ground). Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $\mathfrak{D} = (\mathfrak{M}_{a_1}, \ldots, \mathfrak{M}_{a_n})$ be a discourse model with $\mathfrak{M}_{a_1}, \ldots, \mathfrak{M}_{a_n}$ based on $\mathcal{L}$. Further, let $\phi$ be a formula from $\mathcal{L}$. We say that $\phi$ is common ground if and only if we have for each $\mathfrak{M}_{a_i} (i = 1, \ldots, n)$ that $\phi \in \{ \psi : \psi \in \Sigma_a^w \text{ for each } w \in W \}$ with $a = a_i^{-1}$.

So, an actual commitment of an agent $a$ is a formula to which the agent is committed in every world in $a$’s commitment model. And, a formula is common ground if and only if it is an actual commitment of every agent. The notion of common ground here is related to the notion of a context set then (see Stalnaker (1999) and Stalnaker (2002)).

Finally, we will define an update operator which will give us a good formal representation of assertion, confirmation, and contradiction.

**Definition 10** ($+$-operator). Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $\mathfrak{D}$ be a discourse model $(\mathfrak{M}_{a_1}, \ldots, \mathfrak{M}_{a_n})$ with $\mathfrak{M}_{a_1}, \ldots, \mathfrak{M}_{a_n}$ based on $\mathcal{L}$. Further, let $\phi$ be a formula from $\mathcal{L}$ and $a_i$ be an indexed agent ($i \leq n$). Last, let $W_{\mathfrak{M}_{a_i}}$ be the domain of $\mathfrak{M}_{a_i}$. Then:

$$
+_{\mathfrak{D}}_{a_i} \phi :=
\begin{cases}
\mathfrak{D}' & \text{if } \exists w \in W_{\mathfrak{M}_{a_i}} : \phi \in \Sigma_w^a \\
\text{undefined} & \text{else}
\end{cases}
$$
where $\mathcal{D}'$ is defined as follows:

$$
\mathcal{D}' = (M_{a_1}, \ldots, M_{a_i}, \ldots, M_{a_n}), \text{ with }
$$

$$
M'_{a_i} := (W' := \{ w \in W^{a_i} : \phi \in \Sigma_{a_i}^{-1} \}, \{ R_a \cap (W' \times W') \}_{a \in A}, V'), \text{ with } V'(p) := V(p) \cap W',
$$

for each $p \in \Phi$.

The $+$-operator (read: plus-operator) thus defines the usual update we saw already. Importantly, though, $+$ operates only on the agent indexed model. This is crucial since it allows us to model the first effect of an assertion as an update independently from the second effect. The latter will come about as an overall emerging property of the discourse. An example will illustrate this:

Let us assume that we have two agents $a$ and $b$ and the discourse model $\mathcal{D}$ displayed below. Now, $a$ asserts $\phi$ which results in the following situation:

$$
\Sigma^a = \{ \phi, \psi \}
\Sigma^b = \{ \phi, \chi \}
$$

Figure 2: On the left, we have the agent indexed commitment model for agent $a$, on the right the one for $b$. Reflexive arrows have been omitted.

By convention, the initial discourse model has the same commitment model underlying its agent indexed commitment models. The purple part in the left model denotes the result of the assertion of $\phi$ by $a$. A simple calculation shows that this act results in adding $\phi$ to the actual commitments of $a$. Another simple calculation shows then that $\phi$ is not common ground relative to the discourse model $\mathcal{D}'$, because it is not an actual commitment of $b$. Obviously, if we have that $b$ asserts $\phi$ as well (an act of confirming), $\phi$ will become common ground relative to the discourse model $\mathcal{D}''$. If such act does not occur, no grounding will occur.

As the above already indicated, we will follow Krifka (2015) in treating confirmations (with bare yes) simply as assertions. Similarly, we will follow Krifka (2015) in treating contradictions (with no) as assertions to the contrary.\textsuperscript{13} Hence, the $+$-operator gives us all we need.

3.4. And now for something completely different: weak rejection

Weak rejections have not been discussed in Krifka (2015), however, they are of interest to anyone interested in assertion. While assertions are used in order to get a proposition grounded (their essential effect), weak rejections have a different job: they are used to block this effect.

\textsuperscript{13}Obviously, we do not have the means to model yes or no. So, in fact, our treatment here is more general.
\[
\Sigma^a = \{ \psi, \chi \} \\
\Sigma^b = \{ \phi \}
\]

\[
\Sigma^a = \{ \phi, \psi \} \\
\Sigma^b = \{ \phi, \chi \}
\]

Figure 3: On the left, we have the agent indexed commitment model for agent \(a\), on the right the one for \(b\). Reflexive arrows have been omitted. On the right, in purple the result of confirmation. The update \(+D_b \neg \phi\) is not defined, since \(b\) does not commit to \(\neg \phi\) in any world. So, a contradiction by \(b\) cannot occur in that case.

And that is all there is to them. For an extensive discussion of weak rejections the reader is referred to Incurvati and Schlöder (2017).

We can do the following here:

**Definition 11** (\(-\) operator). Let \(\mathcal{L}\) be a language based on the set of agents \(\mathcal{A}\). Let \(\mathcal{D}\) be a discourse model \((\mathcal{M}_{a_1}, \ldots, \mathcal{M}_{a_n})\) with \(\mathcal{M}_{a_1}, \ldots, \mathcal{M}_{a_n}\) based on \(\mathcal{L}\). Further, let \(\phi\) be a formula from \(\mathcal{L}\) and \(a_i\) be an indexed agent \((i \leq n)\). Last, let \(\mathcal{W}^\mathcal{M}_{a_i}\) be the domain of \(\mathcal{M}_{a_i}\). Then:

\[
-D_{a_i} \phi := \begin{cases} 
\mathcal{D}' & \text{if } \exists w \in \mathcal{W}^\mathcal{M}_{a_i} : \phi \notin \Sigma^a_w \text{ with } a = a_i^{-1} \\
\text{undefined} & \text{else}
\end{cases}
\]

where \(\mathcal{D}'\) is defined as follows:

\[
\mathcal{D}' = (\mathcal{M}_{a_1}, \ldots, \mathcal{M}_{a_i}', \ldots, \mathcal{M}_{a_n}), \text{ with }
\]

\[
\mathcal{M}_{a_i}' := (W' := \{ w \in \mathcal{W}^\mathcal{M}_{a_i} : \phi \notin \Sigma^a_{W'} \}, \{ R_{a_i}(W' \times W') \}_{a \in \mathcal{A}, V'}, \text{ with } V'(p) := V(p) \cap W', \text{ for each } p \in \Phi.
\]

This excludes all worlds from the indexed agent model of \(a_i^{-1}\) where \(a_i^{-1}\) is committed to \(\phi\) thereby blocking any commitment to \(\phi\), which is what we wanted. However, we must note that the above does not entirely match the proposal in Incurvati and Schlöder (2017) since they have a weak rejection involving a public commitment to not committing to a proposition (cf. Incurvati and Schlöder (2017): 756). So, we are missing out on an important point here. This is because of our static-base architecture and could be tackled by adding dynamic operations on commitment sets: we could define an operation which adds formulas to commitment sets and redefine the minus-operator by utilizing that operation plus the notion of consistency. Other possibilities exist.\(^{14}\) We will not pursue such matters here. An example for the minus-operator can be found at the top of the next page.

\(^{14}\)The speech act of weak rejection might be modelled in Krifka (2015) in terms of denegation. It would then be treated as a denegation of committing to the truth of the relevant proposition. The same issues would arise for Krifka (2015).
We will end this section with two propositions.

**Proposition 1.** Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $a_1, \ldots, a_n$ be an enumeration of $\mathcal{A}$. Let $\mathfrak{D}$ be any discourse model based on $\mathcal{L}$, and let $\phi$ be any formula of our language. Then it holds: it is not the case that whenever $\neg^{a_i}_{a_i} \phi$ we also have that $\neg^{a_i}_{C_a} \phi \in \{ \psi : \psi \in \Sigma^a_w \text{ for each } w \in \mathcal{W} \}$ with $a = a_i^{-1}$.

**Proof.** Let $\mathcal{L}$ be defined from $\Phi = \{ p \}$ and $\mathfrak{A} = \{ a \}$. Then, let $\mathfrak{D}$ be the discourse model graphically represented below, where we omitted reflexive arrows. Further, let $\phi = p$.

![Diagram](image.png)

Performing a weak rejection $\neg^{a_i}_{a_i} p$ does not alter the model, and so we will not find that $C_a \neg p$ holds afterwards. \qed}

This property is important, for a weak rejection is different from a contradiction. In weakly rejecting, I am not committing to the contrary of what I am rejecting. Again, we refer to Incurvati and Schlöder (2017) for discussion.

On the other hand Incurvati and Schlöder (2017): 749 suggest that a strong rejection (the speech act of contradicting) entails a weak rejection. This property does not hold in the current setting as the next proposition makes clear.

**Proposition 2.** Let $\mathcal{L}$ be a language based on the set of agents $\mathcal{A}$. Let $a_1, \ldots, a_n$ be an enumeration of $\mathcal{A}$. Let $\mathfrak{D}$ be any discourse model based on $\mathcal{L}$, and let $\phi$ be any formula of our language. Then it holds: it is not the case that whenever we have $+^{a_i}_{a_i} \neg \phi$ we also have that $\neg^{a_i}_{C_a} \phi \in \{ \psi : \psi \in \Sigma^a_w \text{ for each } w \in \mathcal{W} \}$ with $a = a_i^{-1}$.

**Proof.** Again, a very small model suffices. Let $\mathcal{L}$ be defined from $\Phi = \{ p \}$ and $\mathfrak{A} = \{ a \}$. Then, let $\mathfrak{D}$ be the discourse model graphically represented below, where we omitted reflexive arrows. Further, let $\phi = p$.

Here, $+^{a_i}_{a_i} \neg p$ does not alter the initial model. Since $p \in \Sigma^a$ we do not have that $\neg^{a_i}_{C_a} p$. \qed
Importantly, this property holds only if we assume that commitments must be consistent – as Incurvati and Schlöder in fact do (see Incurvati and Schlöder (2017): 756). In principle, we could do so as well. We could impose restrictions on commitment sets in various ways. Alternatively, we could impose modal logical axioms. Again, we will not pursue any of these matters here. Prima facie such changes should not affect our first proposition.

4. Epistemic and doxastic extensions

In this section we will introduce one extension by adding knowledge. Extensions with belief or other modalities are done similarly and therefore will not be discussed. For readers unfamiliar with epistemic logic we refer to van Benthem (2011) once again. We will only provide the basic ingredients and leave specific implementations to the users, meaning that we will not go into any axiomatizations or other topics.

4.1. Adding knowledge

Definition 12 (Epistemic language). Given a set of proposition letters Φ and a set of agents A (which we fix for specific applications), our modal language \( \mathcal{L}_K \) (K for knowledge) is given by the following inductive syntax:

\[
\phi :: p \mid \neg \phi \mid \phi \land \psi \mid C_a \phi \mid K_a \phi, \text{ where } a \in A
\]

Definition 13 (Epistemic commitment frame). Let \( \mathcal{L} \) be a language based on the set of agents A. An epistemic commitment frame is a tuple \( (\mathcal{W}, \{ \Sigma^a_w : a \in A, w \in \mathcal{W} \}, \{ R_a : a \in A \}, \{ \equiv_a : a \in A \}) \), where \( \mathcal{W} \) is a non-empty set of worlds, for each \( a \in A \) and \( w \in \mathcal{W} \), \( \Sigma^a_w \) is a set of formulas \( \phi \) from \( \mathcal{L} \). We call \( \Sigma^a_w \) the commitment set of \( a \) in \( w \). Last, for each \( a \in A \), \( R_a \) is a binary accessibility relation on \( \mathcal{W} \). We set: \( wR_a v \) if and only if \( \Sigma^a_w \subseteq \Sigma^a_v \). Similarly, \( \equiv_a \) is a binary accessibility relation on \( \mathcal{W} \) and is used for encoding knowledge. A common way to do so is to have \( \equiv \) an equivalence relation.

Definition 14 (Epistemic commitment model). An epistemic commitment model \( \mathcal{M} \) is a tuple \( (\mathcal{F}, \mathcal{V}) \) consisting of an epistemic commitment frame \( \mathcal{F} \) and a valuation function \( \mathcal{V} \).

Definition 15 (Semantics).

1. \( \mathcal{M}, w \models p \) iff \( w \in \mathcal{V}(p) \)
2. \( \mathcal{M}, w \models \neg \phi \) iff not \( \mathcal{M}, w \models \phi \)
3. \( \mathcal{M}, w \models \phi \land \psi \) iff \( \mathcal{M}, w \models \phi \) and \( \mathcal{M}, w \models \psi \)
4. \( \mathcal{M}, w \models C_a \phi \) iff for all \( v \in \mathcal{W} \), \( wR_a v \) implies \( \phi \in \Sigma^a_v \)
5. \( \mathcal{M}, w \models K_a \phi \) iff for all \( v \in \mathcal{W} \), \( w \equiv_a v \) implies \( \mathcal{M}, v \models \phi \)

All other definitions from the last section can be adjusted in the same way and so we will not do so here. Belief can be added similarly.
This extension allows to study how the dynamics of commitments influences knowledge. We will, however, not attempt this here. What you cannot do with this system is to study how knowledge influences commitments. This requires an epistemic update operator. A very potential way to do this is to go a step further and to make use of product updates (cf. Baltag et al. (1998)). We will not undertake this here either.\footnote{There are, however, a few papers that propose formalism based on Baltag et al. (1998), for instance Gaudou et al. (2006) Asher and Lascarides (2008), and Venant and Asher (2015). These can easily accommodate knowledge and belief for that matter (in fact, Gaudou et al. (2006) and Asher and Lascarides (2008) include belief). These differ from the current proposal in their treatment of commitments: unlike here, commitments are treated as usual modalities – something we cannot say to be the case here.}

5. Conclusion

This paper addressed assertions and responses to assertions, i.e., confirmations with bare \textit{yes} and contradictions with bare \textit{no}, in commitment space semantics as presented in Krifka (2015). We showed that the formal analysis of these conversational acts is empirically unmotivated and thus asks for revision. We offered instead a new framework taking lead from the architecture of commitment space semantics. Such was motivated by the need to accommodate other phenomena as well, in particular knowledge, belief, and preferences (among other things). Hence, we moved to a modal framework. In this framework we provided empirically grounded analyses of the above speech acts, thereby improving on commitment space semantics. We furthermore showed that with some more effort a treatment of the speech act of weak rejection (Incurvati and Schlöder (2017)) is possible as well. Last, we gave a very basic epistemic extension of the presented framework and indicated how to go even further.

References


Abstract. Adjective ordering preferences (e.g., big blue box vs. blue big box) are robustly attested in many unrelated languages (Dixon, 1982). Scontras et al. (2017) showed that adjective subjectivity is a robust predictor of ordering preferences in English: less subjective adjectives occur closer to the modified noun. In a follow-up to this finding, several authors have claimed that pressures from successful reference resolution and the hierarchical structure of modification explain subjectivity-based ordering preferences (Simonič, 2018; Franke et al., 2019; Scontras et al., 2019). In cases of restrictive modification, adjectives that compose with the nominal later will classify a smaller set of potential referents (e.g., the set of boxes vs. the set of blue boxes). To avoid alignment errors where a listener might mis-characterize the intended referent, speakers introduce the more error-prone (i.e., more subjective) adjectives later in the hierarchical construction of nominal structure; the structure linearizes such that subjectivity decreases the closer you get to the modified noun. The current study explores the predictions of this reference-resolution story by examining adjective ordering cross-linguistically: when adjectives incrementally restrict a nominal denotation, there should be pressure toward subjectivity-based orderings, but, in the absence of incremental restriction, such pressures should not obtain.

Keywords: adjective ordering, subjectivity, hierarchical structure, conjunction, Arabic, English, Spanish, Tagalog.

1. Introduction

Adjective ordering preferences influence the relative order of adjectives in multi-adjective strings, for example big blue box vs. blue big box. English speakers exhibit a robust preference for the former order, such that color adjectives are preferred closer to the modified noun than size adjectives, and this same preference has been reported in a host of unrelated languages (e.g., Dixon, 1982; Sproat and Shih, 1991). Various proposals have been advanced to account for these preferences, from articulated syntactic hierarchies (Cinque, 1994; Scott, 2002) to appeals to psychological accessibility (Whorf, 1945; Martin, 1969) or ease of parsing (Bever, 1970). Recently, proposals that focus on issues of adjective meaning have gained large-scale empirical support.

Scontras et al. (2017) used corpus and behavioral data to show that adjective subjectivity is a robust predictor of adjective ordering preferences in English, such that less subjective adjectives are preferred closer to the modified noun. In big blue box, speakers perceive blue as less subjective than big, and so blue occurs closer to the noun.

In an attempt to explain this robust empirical generalization—that subjectivity predicts adjective ordering preferences—several authors have arrived at the conclusion that ordering ad-

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1We thank the audience and organizers of Sinn und Bedeutung 24 in Osnabrück. Thanks also to members of the Quantitative Language Science Collective at UC Irvine for feedback on earlier versions of this work.
jectives with respect to decreasing subjectivity maximizes communicative success (Simonič, 2018; Hahn et al., 2018; Franke et al., 2019; Scontras et al., 2019). While different authors use different assumptions in their accounts, most agree that pressures from successful reference resolution and the hierarchical structure of nominal modification stand to explain subjectivity-based ordering preferences (Simonič, 2018; Franke et al., 2019; Scontras et al., 2019). In cases of restrictive modification, adjectives that compose with the nominal later will classify a smaller set of potential referents (e.g., the set of boxes vs. the set of blue boxes). To avoid alignment errors where a listener might mis-characterize the intended referent, speakers introduce the more error-prone (i.e., more subjective) adjectives later in the hierarchical construction of nominal structure; the structure linearizes such that subjectivity decreases the closer you get to the modified noun.

The current study explores the predictions of this communicative-efficiency story by examining adjective ordering cross-linguistically: when adjectives incrementally restrict a nominal denotation, there should be pressure toward subjectivity-based orderings, but, in the absence of incremental restriction, such pressures should not obtain. We investigate adjective ordering in both pre-nominal languages where adjectives precede nouns (English, Tagalog) and post-nominal languages where adjectives follow nouns (Spanish, Arabic). We also explore the role of linking particles that mediate the composition of modifiers (Rubin, 1994; Scontras and Nicolae, 2014), contrasting such particles with run-of-the-mill conjunction. Our results further confirm the empirical generalization concerning subjectivity in adjective ordering; the results also add new support for accounts of subjectivity in adjective ordering that rely on incremental semantic restriction that tracks the hierarchical structure of modification.

2. Subjectivity-based ordering preferences

We begin by reviewing the empirical methodology of Scontras et al. (2017), which will serve as the foundation for our empirical investigations. We then review the details of Franke et al.’s (2019) proposal concerning the role of subjectivity in adjective ordering, identifying two predictions made by this proposal.

2.1. Evidence from English

Scontras et al. (2017) investigated whether aspects of adjective meaning explain adjective ordering preferences. Specifically, Scontras et al. tested whether adjectives are ordered with respect to decreasing subjectivity, such that adjectives perceived to be less subjective are preferred closer to the modified noun (Hetzron, 1978; Tucker, 1998; Hill, 2012). The authors began by measuring ordering preferences for 26 relatively frequent adjectives from seven semantic classes. Experimental participants were presented with a series of adjective-adjective-noun pairs that differed in the relative order of the adjectives, and they adjusted a slider to indicate which ordering sounded more natural (e.g., metal tiny chair vs. tiny metal chair in Figure 1). To validate this behavioral measure, Scontras et al. conducted a corpus analysis of naturally-occurring multi-adjective strings. The behavioral and corpus measures were found to be highly correlated ($r^2 = 0.83$), so the authors concluded that the behavioral measure effectively captured ordering preferences that speakers use when they form multi-adjective strings.

To measure subjectivity, Scontras et al. used a faultless disagreement task (Kölbel, 2004; Mac-
Farlane, 2014). Participants were presented with short dialogues in which two speakers disagreed about a property ascription (e.g., whether some cheese was *rotten* in Figure 2). Participants had to decide whether the two speakers could both be right while disagreeing (i.e., whether they could faultlessly disagree), or whether one of the speakers must be wrong. Scontras et al. used an adjective’s potential for faultless disagreement as an index of adjective subjectivity.²

To evaluate the subjectivity hypothesis, Scontras et al. compared their subjectivity scores with the ordering preferences they measured. Subjectivity was found to explain between 85% and 88% of the variance in the ordering preferences. To test the generalizability of their findings, the authors also looked at ordering preferences for 74 adjectives found to naturally occur in multi-adjective strings in the Switchboard corpus of English telephone conversations; subjectivity accounted for 61% of the variance in the ordering preferences for these adjectives. Thus, Scontras et al. found strong evidence in support of their hypothesis: an adjective’s meaning does predict its distance from the noun it modifies, such that less subjective adjectives occur closer to the modified noun.

2.2. Subjectivity-based ordering maximizes communicative success

With clear evidence for the empirical generalization that subjectivity predicts adjective ordering preferences, the task turns next to explaining why subjectivity should play its role in adjective ordering. A number of proposals have recently been put forth, and, while they rely on different sets of assumptions, all of these proposals agree that adjectives are ordered with respect to decreasing subjectivity in an effort to maximize the communicative success of multi-adjective nominals (Simonič, 2018; Hahn et al., 2018; Franke et al., 2019; Scontras et al., 2019). In other words, multi-adjective strings ordered with respect to decreasing subjectivity are more likely to allow a speaker to successfully communicate their intended message to a listener. Here, we

²In a separate experiment, Scontras et al. measured subjectivity by asking participants how “subjective” a given adjective was. These raw subjectivity scores were found to be highly correlated with estimates of faultless disagreement ($r^2 = 0.91$). We use raw the subjectivity scores from Scontras et al. in our analysis of English conjunction below.
review the specific proposal advanced by Franke et al. (2019), pointing out places where its assumptions overlap with those of other accounts.

The starting observation for all of the recent accounts of subjectivity-based adjective ordering is that less subjective content is, in a sense to be specified, more useful for effectively and efficiently communicating about the world. When a listener hears the adjective blue, the set of potential referents they imagine is likely to be more constrained or less variable than the set of referents they imagine when hearing big; we find evidence of this divergence reflected in the different faultless disagreement scores assigned to the two adjectives. When determining the order of a multi-adjective string, the descriptive generalization is that speakers prefer to place more useful, less subjective content closer to the modified noun. To see why, we have to consider in more detail the adjectives’ semantics.

Franke et al. (2019) focus on uses of adjectives that aid in establishing nominal reference. Thus, their aim is to make precise the notion that less subjective adjectives are more useful for successful reference resolution, and show that subjectivity-based adjective ordering leads to greater success. The authors assume the empirically-motivated context-dependent semantics from Schmidt et al. (2009). Under this semantics, an adjective like big characterizes those objects that meet the contextual cutoff for size. The cutoff is calculated on the basis of relative height by range, such that any object that falls within the top $k\%$ of the range of sizes in the context $C$ counts as big in $C$. The corresponding lexical entry for big appears in (1), where $\text{size}(x)$ finds the size of some object $x$, $\text{max}$ is the size of the largest object in $C$, $\text{min}$ is the size of the smallest object in $C$, and $\theta = k/100$.

$$(1) \quad [\text{big}]_C^C = \lambda x \in C. \text{size}(x) \geq (\text{max} - \theta \cdot (\text{max} - \text{min}))$$

Suppose the maximum object size in $C$ is 10 (on some arbitrary scale), the minimum is 2, and we set the relevant threshold $k$ at 50%; with these settings, the size cutoff for big would be 6, so that any object with size 6 or greater would count as big in $C$.

Franke et al. further assume that sequential adjetival modification, as in multi-adjective nom-

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3This focus is shared by Simonič (2018) and Scontras et al. (2019).
inals like *big blue box*, can trigger sequentially intersective updates to the context.\(^4\) This move has adjectives farther from the noun interpreted with respect to contexts that have already been restricted by any closer adjectives. Thus, a phrase like *big blue box* can be interpreted as characterizing the set of blue boxes that count as big for the blue boxes in \(C\). In (2), we schematically represent this incremental semantic restriction for multi-adjective nominals with two adjectives.

\[
[A_2 \ A_1 \ N] = [[A_2]] \subseteq [[N]] \cap \mathcal{C}
\]

For Franke et al., noise—what we described above in terms of differential communicative utility—enters at the level of perception as agents create their subjective representations of the discourse context.\(^5\) Whatever the true context, each agent arrives at their own representation. Crucially, more subjective properties (e.g., size) are assumed to more commonly lead to deviations between the true context and an agent’s representation. Because each conversational agent independently arrives at their own subjective representation of the context, more subjective properties more commonly lead to deviations between the two agents’ representations. Franke et al. propose that these deviations and our awareness of them contribute to an adjective’s perceived subjectivity.

With these assumptions in place, Franke et al. simulated 1,000,000 contexts (i.e., sets of potential referents) and recorded the probability of a listener correctly retrieving the intended referent on the basis subjectivity-based orderings (e.g., *big blue box*) vs. non-canonical reverse orderings (e.g., *blue big box*). By performing these comparisons, the authors compared two hypothetical groups of speakers, asking which has higher communicative success: the group using subjectivity-based orderings, or the group using the reverse orderings. The results clearly demonstrated that, on average, subjectivity-based orderings are more likely to lead to communicative success. Thus, the authors provide an evolutionary rationale for why natural languages prefer one ordering over another: subjectivity-based orderings are more conducive to our communicative aims. Crucially, this explanation does not require active reasoning comparing adjective subjectivity as speakers form their multi-adjective strings. Rather, certain orderings (i.e., the subjectivity-based ones) will turn out to be more useful to speakers in the long run, and so those orderings are more likely to stick around in the language. Language users will more commonly encounter those more useful subjectivity-based orderings, and so production can simply mirror the statistics of the input to yield robust subjectivity-based ordering preferences.

2.3. Predictions

We have a robust empirical generalization—subjectivity predicts adjective ordering preferences—and a proposal meant to explain the generalization—subjectivity-based adjective ordering maximizes communicative success. We now explore two predictions of this proposal, which we will test empirically below.

First, if communicative pressures deliver subjectivity-based ordering when adjectives incrementally restrict a nominal denotation, then we should find that these pressures apply whenever

\(^4\)This assumption is shared with Simonič (2018) and Scontras et al. (2019).

\(^5\)Here is a point where the assumptions of Franke et al. deviate from those of other authors. Simonič (2018), Hahn et al. (2018), and Scontras et al. (2019) build the noise associated with subjectivity directly into the semantics of adjectives.
we have configurations of adjectives that result in incremental semantic restriction. Specifically, we should find subjectivity-based adjective ordering preferences in both pre-nominal languages like English, where adjectives precede the modified noun, and in post-nominal languages like Spanish or Arabic, where adjectives follow the noun. Such structures are given schematically in (3).

(3)   a.  Pre-nominal structure:
       \[
       \text{big} \quad \text{blue} \quad \text{box}
       \]
   b.  Post-nominal structure:
       \[
       \text{box} \quad \text{blue} \quad \text{big}
       \]

Recall the explanation from Franke et al. (2019) above: in cases of restrictive modification, adjectives that compose with the nominal later will classify a smaller set of potential referents (e.g., the set of boxes vs. the set of blue boxes); to avoid alignment errors where a listener might mis-characterize the intended referent, speakers introduce the more error-prone (i.e., more subjective) adjectives later in the hierarchical construction of nominal structure; the structure linearizes such that subjectivity decreases the closer you get to the modified noun. Crucially, the explanation applies regardless of whether the noun precedes or follows the noun. In (3), either configuration has adjectives farther from the noun composing later and therefore operating over a restricted set of potential referents. Thus, with either configuration, we predict that communicative pressures should interact with the hierarchical structure of multi-adjective modification to deliver subjectivity-based preferences.

Second, we predict that subjectivity-based preferences should not arise in the absence of incremental semantic restriction. Put differently, whenever the hierarchical structure is such that adjectives are not composing sequentially with the modified nominal, communicative pressure toward subjectivity-based ordering should not apply. One structure that disrupts incremental semantic restriction is multi-adjective strings formed via conjunction, as in (4).

(4)  Conjoined structure:
       \[
       \text{big} \quad \text{and} \quad \text{blue} \quad \text{box}
       \]

With conjunction, the adjectives make their semantic contribution (i.e., restriction of the relevant context) together after they are conjoined, so pressures mediating the order in which adjectives make that contribution should not apply. Indeed, conjunction has been claimed to neutralize ordering preferences in English (e.g., Ford and Olson, 1975; Byrne, 1979), leading to the acceptability of otherwise unacceptable orderings. For example, while we might strongly disprefer \text{blue big box}, the same ordering formed via conjunction should be acceptable: \text{blue and big box}.

The remainder of the paper explores the predictions of this reference-resolution story for subjectivity-based preferences by examining adjective ordering cross-linguistically: when adjectives incrementally restrict a nominal denotation, there should be pressure toward subjectivity-based
orderings, but, in the absence of incremental restriction, such pressures should not obtain.

3. Testing the predictions

3.1. Tagalog

We begin with a look at Tagalog, a pre-nominal language where adjectives require a linking particle (-ng/na) to participate in modification structures (Foley, 1975; Rubin, 1994). An example multi-adjective nominal appears in (5); note the obligatory presence of LINKER.

(5) malaki-ng asul na mesa
   big-LK blue LK desk
   ‘big blue desk’

Tagalog’s LINKER appears in the presence of modification; some have analyzed the semantic contribution of LINKER similarly to that of conjunction, as in (6) (Rubin, 1994; Scontras and Nicolae, 2014).

(6) a. \([\text{LINKER}] = \lambda P\lambda Q\lambda x. \ P(x) \land Q(x)\)
   b. XP
      \(\text{ModP}\)
      \(\text{XP}\)
      \(\text{YP} \quad \text{Mod}^0 \quad \ldots\)
      \(\ldots \quad \text{LK}\)

As noted above, in English, conjunction has been claimed to neutralize adjective ordering preferences. We might therefore expect that Tagalog’s LINKER, with its conjunction-like semantics, also neutralizes ordering preferences. However, even if LINKER discharges the semantics of modification, adjectives still compose incrementally with the nominal. In (7), it is still the case that adjectives closer to the noun restrict the nominal denotation before adjectives that are farther away. If subjectivity-based preferences derive from incremental semantic restriction, these preferences should surface in Tagalog.

(7) NP
    \(\text{ModP}\)
    \(\text{NP} \quad \text{AP} \quad \text{Mod}^0 \quad \text{NP} \quad \text{AP} \quad \text{Mod}^0 \quad \text{NP}\)
    \(\text{‘big’} \quad \text{LK} \quad \text{‘desk’} \quad \text{LK}\)

We therefore set out to determine (i) whether Tagalog possesses ordering preferences in the presence of LINKER, and, if so, (ii) whether subjectivity predicts those preferences.

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6The material in this section summarizes the findings of Samonte and Scontras (2019).
Figure 3: Tagalog naturalness ratings grouped by adjective semantic class. Higher values indicate that a class’s adjectives are preferred farther from the modified noun; lower values indicate that a class’s adjectives are preferred closer. The dashed line indicates chance level, or the absence of stable preferences. Error bars represent bootstrapped 95% confidence intervals drawn from 10,000 samples of the data.

3.1.1. Measuring preferences

We replicated Experiment 1: Ordering preferences from Scontras et al. (2017) using Tagalog translations of the original English materials.  

Participants. We recruited 90 participants through Amazon.com’s Mechanical Turk. On the basis of their responses to a post-test questionnaire, 24 Tagalog-speaking participants were identified; we include their data in the analyses reported below.

Procedure. Participants indicated their preferences for pairs of multi-adjective strings formed from 26 unique adjectives from seven semantic classes paired with ten nouns; the pairs differed on the relative order of the adjectives (e.g., *malaking asul na mesa* ‘big blue desk’ vs. *asul na malaking mesa* ‘blue big desk’). On each trial, adjectives and nouns were randomly chosen, with the constraint that the two adjectives were from different semantic classes. Participants completed a series of 26 trials.

Results. We averaged across participants’ ratings to calculate a single preferred-distance measure for each adjective; values ranged from 0 (always preferred closest to the noun) to 1 (always preferred farthest from the noun). Figure 3 plots the preferred-distance measures grouped by adjective class. All but the age adjectives deviate significantly from the random baseline (i.e., from 0.5), suggesting that Tagalog does indeed have stable preferences: some adjectives are reliably preferred closer to the noun, while others are reliably preferred farther away. Thus, we find strong evidence in support of stable ordering preferences in Tagalog, despite the obligatory LINKER.

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7See Samonte and Scontras (2019) for the full details of the materials.
3.1.2. Measuring subjectivity

We next measured adjective subjectivity in Tagalog using a faultless disagreement task (cf. Expt. 1: Faultless disagreement validation from Scontras et al., 2017): to the extent that two speakers can be right while disagreeing about a property, the property admits that degree of faultless disagreement, which indexes adjective subjectivity.

Participants. We recruited 45 participants through Mechanical Turk; participants who had taken part in the ordering preferences experiment were not eligible. We identified eleven Tagalog speakers on the basis of their responses to a post-test questionnaire.

Procedure. Participants encountered a series of dialogues in which two speakers disagreed about a property description (e.g., whether or not some desk was ‘blue’). The task was to determine whether the two speakers could both be right while disagreeing (i.e., whether they could faultlessly disagree), or whether one speaker must be wrong. Participants completed a series of 26 trials, one for each of the adjectives tested in the ordering preferences experiment.

Results. Responses ranged from 0 (‘only one can be right’) to 1 (‘yes, it depends on what you believe’). For each adjective, we computed a mean faultless disagreement score by averaging across participants’ responses. We will use these subjectivity scores in the following subsection.

3.1.3. Comparing ordering preferences with subjectivity

With measures of the Tagalog ordering preferences and adjective subjectivity, we can ask whether subjectivity predicts those ordering preferences. Figure 4 plots ordering preferences against subjectivity scores for each of the 26 adjectives tested. There, we see that in Tagalog, as in English, subjectivity is a reliable predictor of individual adjective ordering preferences. Despite using diverging strategies to form modification structures, in both languages adjectives compose incrementally with the modified noun, which leads to subjectivity-based adjective ordering preferences.

3.2. Spanish

We turn next to Spanish, where multi-adjective strings are post-nominal and commonly formed via conjunction (e.g., el escritorio grande y azul ‘the big and blue desk’). Some adjectives may occur pre-nominally; however, this strategy is not fully productive in the language. We therefore focused only on post-nominal multi-adjective strings. To investigate ordering preferences in Spanish, we replicated the methodology from Scontras et al. (2017) using Spanish translations of the English materials. Given that many speakers express a preference for multi-adjective strings formed via conjunction, we ran two separate ordering preferences experiments, with and without conjunction.

8Portions of the material in this section summarize the findings of Rosales Jr. and Scontras (2019); the conjunction-free results are novel.

9See Rosales Jr. and Scontras (2019) for full details.
3.2.1. Measuring preferences with conjunction

We replicated the ordering preferences experiment described above for Tagalog, here using Spanish materials that always featured conjunction in the formation of multi-adjective strings.

Participants. We recruited 224 participants through Mechanical Turk; 48 were identified as native speakers of Spanish on the basis of a post-test questionnaire.

Procedure. The procedure was identical to the Tagalog ordering preferences experiment with the exception that adjectives were conjoined to form multi-adjective strings.

Results. Figure 5 plots average preferred-distance measures grouped by adjective class. We see that for all but one of the classes (i.e., the quality adjectives), participants did not provide systematic ratings that would evidence stable ordering preferences. In other words, from their responses we see that participants do not have clear preferences to place certain classes of adjectives closer or farther from the modified noun; we find a similar pattern at the level of individual adjectives.

3.2.2. Measuring preferences without conjunction

Although our consultants indicated a preference to use conjunction in multi-adjective strings, after publishing the initial results in Rosales Jr. and Scontras (2019), we learned that some speakers do not consider conjunction necessary for forming multi-adjective strings. Therefore, we repeated the Spanish ordering preferences experiment, this time without conjunction between the relevant adjectives.

Participants. We recruited 180 participants through Mechanical Turk, of which 22 were identified as native speakers of Spanish on the basis of a post-test questionnaire.
Figure 5: Spanish naturalness ratings for conjoined strings grouped by adjective semantic class.

Figure 6: Spanish naturalness ratings for strings without conjunction grouped by adjective semantic class.

Procedure. The procedure was identical to the Spanish ordering preferences experiment above, with the exception that here we measured preferences for multi-adjective strings without conjunction.

Results. Figure 6 plots average preferred-distance measures. In contrast to the results in Figure 5, without conjunction we see clear evidence of ordering preferences in Spanish: certain classes are preferred closer to the noun (i.e., size, age), and others are preferred farther away (i.e., nationality, color).

3.2.3. Measuring subjectivity

To measure subjectivity, we replicated the faultless disagreement task using Spanish materials.

Participants. We recruited 106 participants through Mechanical Turk; 21 participants were identified as native speakers of Spanish.

Procedure. The procedure was identical to the faultless disagreement experiment described
Comparing ordering preferences with subjectivity. We have two cases to check: first, ordering preferences with conjunction, and second, ordering preferences without conjunction. With conjunction, subjectivity fails to predict ordering preferences (Figure 7, left). This prediction failure arises because, as we saw above, there are no ordering preferences to predict in Spanish when multi-adjective strings are formed via conjunction. In contrast, without conjunction, subjectivity is a robust predictor of ordering preferences (Figure 7, right). We therefore find the prediction regarding conjunction borne out: conjunction neutralizes ordering preferences, at least in Spanish. Without conjunction, we find subjectivity-based ordering preferences post-nominally, a finding also in line with the predictions of incremental semantic restriction as a driver of subjectivity-based preferences.

3.3. Arabic

While Spanish stands apart with its preference for conjunction in multi-adjective strings, it also stands apart—at least relative to English and Tagalog—with its post-nominal adjectives. Here we test another language with post-nominal adjectives: Arabic.\(^\text{10}\) Unlike Spanish, Arabic speakers do not report a general preference for conjunction in multi-adjective strings.

\(^\text{10}\)The material in this section summarizes portions of the findings from Kachakeche and Scontras (2020).
3.3.1. Measuring preferences

We replicated the ordering preferences experiment (without conjunction) using Arabic translations of the English materials. Given that participants indicated preferences for written strings, testing proceeded using Modern Standard Arabic.

Participants. We recruited 135 participants through Mechanical Turk; 24 were identified as native speakers of Arabic on the basis of a post-test questionnaire.

Procedure. The procedure was identical to the ordering preferences experiments presented above, with the exception that instructions and materials appeared in Arabic.

Results. Figure 8 plots average preferred-distance measures, demonstrating clear evidence of stable ordering preferences in Arabic: some classes of adjectives are preferred farther from the noun, while others are preferred closer.

3.3.2. Measuring subjectivity

To measure subjectivity, we replicated the faultless disagreement task using Arabic materials.

Participants. We recruited 135 participants through Mechanical Turk; 16 were identified as native speakers of Arabic.

Procedure. The procedure was identical to the faultless disagreement experiments described above, with Arabic translations of the instructions and test items. For each adjective, we computed a mean faultless disagreement score by averaging participants’ responses.

Comparing ordering preferences with subjectivity. Figure 9 plots adjective ordering preferences against the mean subjectivity scores for each of the adjectives tested. In Arabic, subjectivity is a robust predictor of adjective ordering preferences, thereby further confirming the prediction that subjectivity-based ordering preferences should arise whenever the hierarchical structure of modification supports them, whether pre- or post-nominally.

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Figure 8: Arabic naturalness ratings grouped by adjective semantic class.

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11See Kachakeche and Scontras (2020) for details.
3.4. English conjunction

So far, we have found clear evidence of stable ordering preferences despite the obligatory presence of \textsc{linker} in Tagalog, stable ordering preferences in post-nominal strings in both Spanish and Arabic, and no ordering preferences in the presence of conjunction in Spanish. With the results concerning the absence of stable preferences with conjunction in Spanish, we set out to confirm reports in the literature that conjunction neutralizes ordering preferences also in English (Ford and Olson, 1975; Byrne, 1979).

3.4.1. Measuring preferences

We re-ran the English ordering preferences experiment from Scontras et al. (2017), this time conjoining adjectives in multi-adjective strings.

\textit{Participants.} We recruited 50 participants through Mechanical Turk; 49 were identified as native speakers of English.

\textit{Procedure.} The experiment was a direct replication of the ordering preferences experiment from Scontras et al., with the exception that participants rated multi-adjective strings formed with conjunction.

\textit{Results.} Figure 10 plots average preferred-distance measures. Unlike in Spanish, English speakers continue to have stable ordering preferences even with conjunction. Moreover, the English conjunction ratings closely replicate the qualitative results from the conjunction-free baseline observed by Scontras et al.
Having documented stable ordering preferences with conjunction in English, next we check the extent to which subjectivity predicts those preferences. To do so, we used the subjectivity scores measured by Scontras et al.; as Figure 11 shows, subjectivity continues to be a robust predictor of ordering preferences with conjunction in English ($r^2 = 0.68$; 95% CI [0.45, 0.80]). This finding stands at odds with our finding that conjunction neutralizes ordering preferences in Spanish, as well as with previous claims about the role of conjunction in English ordering preferences (Ford and Olson, 1975; Byrne, 1979). However, it is true that ordering preferences are less robust with conjunction than without it: as Figure 11 shows, while subjectivity accounts for 68% of the variance in the conjunction preferences, it accounts for 85% of the variance in preferences without conjunction, in large part because the preferences without conjunction are more extreme.

4. Discussion

The explanation for subjectivity-based adjective ordering preferences in terms of incremental semantic restriction (Simonič, 2018; Franke et al., 2019; Scontras et al., 2019) makes clear predictions about where we should expect to find communicative pressure toward these preferences. First, whenever adjectives incrementally restrict a nominal denotation—whether pre- or post-nominally—there should be pressure toward subjectivity-based ordering. Second, in the absence of incremental semantic restriction—as in the case of conjoined adjectives—such pressures should not obtain. In this paper, we set out to test both sets of predictions using cross-linguistic data obtained in a series of eight experiments.

First, regarding where we should expect to find preferences, we tested pre-nominal adjectives in Tagalog formed with the obligatory LINKER. Even if LINKER receives a semantics similar to conjunction, as some have proposed (Rubin, 1994; Scontras and Nicolae, 2014), its structure is such that adjectives compose incrementally with the nominal: adjectives closer to the modified noun restrict the nominal denotation before adjectives that are farther away. Thus, we should expect that speakers prefer to use less error-prone, less subjective adjectives earlier in this incremental process, and, indeed, we found just this pattern: in Tagalog, speakers have robust
subjectivity-based adjective ordering preferences.

We should also expect to find subjectivity-based adjective ordering preferences in languages with post-nominal adjectives where linear distance tracks the hierarchical structure of semantic composition, for example in Spanish and Arabic. We found straightforward evidence of post-nominal subjectivity-based ordering preferences in Arabic. We also found such preferences in Spanish. However, in Spanish, the empirical picture is complicated by a preference for conjunction in multi-adjective strings. Only in strings formed without conjunction do we find stable ordering preferences.

The point about conjunction confirms our second prediction regarding where we should not expect to find subjectivity-based ordering preferences. In Spanish, conjunction neutralizes ordering preferences. This effect makes sense if the pressure for ordering preferences comes from a desire to compose less subjective adjectives earlier with the modified noun; with conjunction, as in (4), the adjectives make their semantic contribution together after they are conjoined, so pressures mediating the order in which adjectives compose cannot apply. (It is not clear how one would explain this result under a memory-based ordering account, given that relative distance is preserved with conjunction; pace Hahn et al., 2018.)

But the story on conjunction does not end there. In English, preferences weaken but persist in the presence of conjunction. One way to understand the English result is that in languages where multi-adjective strings optionally feature conjunction (as in English), the regularity introduced in conjunction-less strings can bleed over to strings with conjunction. English speakers thus internalize the statistical ordering regularity from non-conjoined adjective strings and use that knowledge to inform preferences for conjoined strings. In Spanish, where speakers commonly prefer conjunction in multi-adjective strings, there may be less of a source for an ordering regularity—conjunction-free strings are dispreferred and therefore occur less frequently—that could be extended by analogy to the conjoined strings.
Before concluding, there is one more point that warrants comment. While we have focused on the similarities across languages in terms of subjectivity-based ordering preferences, there are also differences in our results. Some languages exhibit a stronger correlation between their ordering preferences and adjective subjectivity (e.g., Arabic, English), while others exhibit weaker correlations (e.g., Tagalog, Spanish). At the level of adjective classes, we find qualitative differences in ordering preferences across languages. While these differences no doubt arise in part because of the idiosyncratic details of our studies (e.g., noise in our data introduced by the availability of subjects), there are likely other, more meaningful factors at play. For example, if we follow Franke et al. (2019) in assuming that ordering preferences develop as speakers internalize the statistical regularities of their input, if the input contains fewer multi-adjective strings, there will be less data to serve in the formation of preferences, and so we might predict weaker preferences overall—a possibility in the case of the weaker preferences observed in conjunction-free strings in Spanish. We leave it to future research to more fully explore this issue.

5. Conclusion

Our results provide further support for the empirical generalization concerning subjectivity in adjective-ordering preferences, as well as support for the role of incremental semantic restriction in subjectivity-based ordering preferences. In Tagalog and Arabic, where adjectives incrementally restrict the nominal denotation, we find subjectivity-based preferences regardless of whether adjectives appear with linking particles or whether they appear pre- or post-nominally. In Spanish, the presence of subjectivity-based preferences depends on whether multi-adjective strings are formed via conjunction: only without conjunction do we find stable ordering preferences in Spanish, and those preferences track adjective subjectivity. Thus, when conjunction disrupts the hierarchical structure that would deliver incremental restriction, pressure toward subjectivity-based ordering disappears. The complicating factor is the picture from English, where preferences weaken but persist with conjunction, suggesting that the regularity introduced in conjunction-less strings can bleed over to strings with conjunction if there exists sufficient support in the input.

References


Until-phrases as obligatory free choice items
Frank STANISZEWSKI — Massachusetts Institute of Technology

Abstract. Following Mittwoch (1977), Iatridou and Zeijlstra (to appear), I attempt a unified account of until (which has proven challenging for reasons I discuss). I propose a basic weak meaning, which obligatorily strengthens in upward-entailing environments in a manner similar to free-choice. Infelicity then results in cases where this strengthened meaning contradicts contextual knowledge about the sentences that the until phrase modifies. I argue that this account avoids the empirical problems of previous accounts, and also provides a way to understand until’s status as a ‘strong’ NPI: Its restricted distribution in (merely) Strawson downward-entailing environments can be explained with independently motivated mechanisms governing the interaction between presuppositions and implicatures.

Keywords: negative polarity, free choice, tense, temporal adverbials, exhaustivity, implicatures, presuppositions.

1. Introduction
1.1. Until’s puzzling distribution
The paradigm in (1)-(2) presents a challenge for an analysis of until. Its use in (1a-b) can appear with or without negation, while its use in (2a-b) requires negation (see Karttunen, 1974; Mittwoch, 1977; and many others).

(1) a. Charlie was asleep until nine.
   b. Charlie wasn’t asleep until nine.
(2) a. *Hana left until nine.
   b. Hana didn’t leave until nine.

Before proposing an account of the paradigm in (1)-(2), the following subsections will discuss additional data that has proven challenging for previous unified analyses of until-phrases (UPs).

1.2. Scopal account
Mittwoch (1977), a.o. propose a uniform meaning for UPs as adverbials that select for predicates with the subinterval property (whenever a predicate holds at an interval, it also holds at every one of its subintervals). This rules out telic VPs like (2a). The acceptability of (2b) then requires until to scope over the negated VP as in (3) (with the additional assumption that negation is a predicate modifier that can create a [+subinterval] predicate).

(3) [ until nine [NOT [Hana left ] ] ]

Assuming that UPs can scope freely with negation then gives rise to an ambiguity when they combine with atelic VPs like in (1b). The “not-throughout” reading corresponds to a parse with negation scoping over until (consistent with a situation where Charlie was asleep, but woke up

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1 For helpful comments, I thank Itai Bassi, Cleo Condoravdi, Keny Chatain, Luka Crnić, Kai von Fintel, Danny Fox, Naomi Francis, Anastasia Giannakidou, Martin Hackl, Sabine Iatridou, Filipe Kobayashi, Paul Marty, Vincent Rouillard, Roger Schwarzschild, Dóra Kata Takács, Hedde Zeijlstra, audiences at CreteLing 2019 and SuB 24, and anonymous SuB reviewers. All mistakes are my own.

at eight). The “throughout-not” reading corresponds to until scoping over negation (throughout a salient interval that ends at nine, Charlie was not asleep).

1.3. Against a scopal account

While elegant, this unified view is challenged by a contrast in the status of the actuality inference (AI) that is associated with UPs depending on the presence of negation (Karttunen, 1974). When a [-subinterval] predicate is negated, it comes with a non-cancelable AI (that the event occurred), as illustrated by the infelicity of the continuation in (4a).\(^2\) With [+subinterval] predicates in positive sentences, however, this inference is cancelable, as in (4b). If negation creates a [+subinterval] predicate for until to modify, (4a-b) should behave similarly, contrary to fact. Once wide scope of until over negation is assumed, it becomes hard to understand the contrast.

(4) a. Hana didn’t leave until 9... #I don’t know if she left later.
 b. Hana was home until 9... I don’t know if she left later.

This is a key motivation for Karttunen’s proposal that there are two untils. One combines with [-subinterval] predicates, is an NPI, and comes with an obligatory AI, and the other combines with [+subinterval] predicates, is not an NPI, and has a cancelable AI. Other researchers have also argued for a lexical ambiguity (Giannakidou, 2002; Condoravdi, 2008, a.o.). I assume that reasons of parsimony favor unified accounts and will not discuss two until approaches further for reasons of space. I direct the reader to Iatridou and Zeijlstra (to appear) for a survey of the key cross-linguistic arguments.

1.4. Iatridou and Zeijlstra’s unified account

Iatridou and Zeijlstra (to appear) (I&Z) propose a unified account of UPs within the broader context of an analysis that includes the in years class of strong NPIs. While space limitations prohibit a detailed discussion of their analysis and the points of connection with in years, this section introduces some of the elements that I adopt in my proposal as well as the crucial points of departure. As a starting point, I&Z adopt Chierchia (2013)’s analysis of NPIs and assume that UPs are scalar items that trigger subdomain alternatives (alternative propositions involving quantification over subsets of an original domain). These then must be factored into the meaning through an exhaustification operator that negates stronger alternatives. Depending on the polarity of the logical environment, exhaustification can then negate alternatives that contradict the assertion and lead to ungrammaticality (thus polarity sensitivity).

I&Z then modify Chierchia’s analysis in a setting where UPs interact with grammatical aspect in crucial ways. They assume that UPs set the right boundary of an interval that they call the until time span (UTS), which serves as the topic time of a clause. The relation between VP event time and topic time is then mediated by aspectual operators (PFV = VP time is contained in topic time; IMPF = Topic time is contained in VP time (Klein, 2013; a.o.)).

(5) \([\text{PFV}\phi]' = 1 \text{ iff } \exists t' \subseteq t: \quad [\phi]' = 1\)

(6) \([\text{IMPF}\phi]' = 1 \text{ iff } \exists t' \supseteq t: \quad [\phi]' = 1\)

Key to this analysis is that the interaction of exhaustification with the containment relations

\(^2\)See Karttunen (1974), Condoravdi (2008), Iatridou and Zeijlstra (to appear) for similar data that supports the AI contrast.
specified by grammatical aspect then determines the polarity of the environments the constructions can appear in.

With perfective VPs in positive sentences, subdomain alternatives that assert that VP time is contained in a smaller topic time (=UTS) interval are stronger than those that assert containment in a larger interval. Since these are stronger alternatives, they all are negated by the exhaustivity operator, which leads to a logical contradiction with the assertion. Under negation, however, the alternatives are entailed and don’t create contradictory implicatures. This means that UPs require a negative environment when they modify perfective VPs.

When UPs modify imperfective VPs, however, entailment relations are reversed. Similar to the way ∃ quantification is downward-entailing (DE) on its domain, the subdomain alternatives that assert that a smaller topic time interval is contained within VP time are weaker than ones that assert that a larger interval is contained within VP time. This means that UPs that modify imperfective VPs do not require negation. These are in fact PPIs that require local exhaustification under negation.3 This relates ungrammaticality of non-negated until to formal perfectivity.

1.5. Outline

The goal of this article is to provide a new analysis for UPs that builds on the accounts reviewed above but avoids some of their empirical problems. Section 2 lays out the challenges to these accounts, and sections 3-4 introduce the new analysis and its technical implementation. Section 5 discusses how the current proposal provides a way to understand until’s status as a ‘strong’ NPI. Section 6 introduces open issues and concludes.

2. Challenge to previous unified accounts

2.1. UPs modifying perfective activity predicates do not require negation

A result of I&Z’s unified account of UPs as discussed above is given in (7).

(7) Interaction of exhaustification with the relations specified by aspect results in:
   a. UPs require a negative environment when they modify perfective VPs
   b. UPs do not require a negative environment when they modify imperfective VPs
      (which is equivalent to ∃ quantification and is DE on its domain)

This analysis accounts for the pattern (1)-(2), but it incorrectly predicts ungrammaticality for a large class of activity predicates, like sleep which are perfective, but appear with non-negated until, as in (8).4

(8) Charlie slept until nine.

The following shows that sleep cannot be imperfective in the crucial sense that affects entailment (VP event time cannot contain topic time). To support this, note that sleep gives rise to readings with obligatory backshift with a past tense embedded under another past, as in (9a).

Also, sleep is ungrammatical in the simple present, as in (9b).

(9) a. Hana said that Charlie slept. (only backshift possible)
    cf. Hana said that Charlie was sleeping. (simultaneous reading possible)

3This follows Zeijlstra (2017)’s analysis of universal PPIs.
4See also Karttunen (1974) for similar examples.
b. #Charlie sleeps. (# on non-habitual reading)  
   cf. Charlie is sleeping. (OK on non-habitual reading)

The grammaticality of (8) given (9) motivates an analysis that more directly reflects Mittwoch’s insight relating the ungrammaticality of (2a) not to formal perfectivity but directly to the subinterval property. I&Z acknowledge cases like (8), and rightly argue that it is the subinterval property that is crucial for modification by until in positive sentences, and that perfectives like *sleep have this property due to the absence of a culmination. While this is true, I suggest that this poses a non-trivial problem for their implementation, which relies crucially on entailment relations that result directly from the meanings of the grammatical aspectual heads. The account I offer avoids this problem and will also be argued to have additional advantages in section 5. Given this, and the aforementioned problem of Mittwoch’s account in capturing the constrast in cancelability of the AI, the challenge for a unified account is summarized in (10).

(10) a. Give an account for why UPs modifying [-subinterval] predicates require negation ((11a-b)) that doesn’t rely on wide scope for until, as this makes it impossible to capture the AI contrast between negated and positive until ((12a-b)).  
b. Account for grammaticality of UPs modifying perfectives like *sleep ((8)).

(11) a. *Hana left until nine.  
b. Hana didn’t leave until nine.

(12) a. Hana didn’t leave until 9... #I don’t know if she left later.  
b. Hana was home until 9... I don’t know if she left later.

3. Overview of the proposal

3.1. The basic paradigm

Under negation, sentences like (11b) are good because until scopes under negation, where it has a weak, existentially quantified meaning (similar to before). In upward-entailing (UE) environments like (11a), it strengthens obligatorily to a universal meaning (similar to throughout). This strengthening happens uniformly with perfective and imperfective VPs, but leads to infelicity only when it applies to [-subinterval] VPs (like leave), as contextual (world) knowledge tells us that they cannot be true throughout an interval.

3.2. Analogy with Free Choice:

UPs behave similar to free-choice disjunction (FC), which exhibits a strong conjunctive meaning in UE sentences and a weak disjunctive one under negation.

(13) a. You are allowed to sing or dance. (⋄[p ∨ q])  
   ≈ You are both allowed to sing and allowed to dance. (⋄p ∧ ⋄q).

b. You aren’t allowed to sing or dance. (¬⋄[p ∨ q])  
   ∼≡ You aren’t both allowed to sing and allowed to dance. (¬[⋄p ∧ ⋄q]).

Kratzer and Shimoyama (2002), Fox (2007), a.o. argue that the basic meaning is the weak one, which undergoes strengthening in UE environments but remains basic under negation. A growing body work extends FC analyses to different domains (Bowler, 2014; Bar-Lev and Margulis, 2014; Meyer, 2015; Bassi and Bar-Lev, 2016; Singh et al., 2016, a.o.). I propose a
similar account for *until*.

3.3. Contrast in distribution and AI

To derive the properties of UPs with a uniform mechanism, I follow I&Z in assuming that UPs interact with exhaustification in important ways but make crucially different assumptions about the alternatives and the way they contribute to the meaning. Rather than relying on the quantificational contribution of aspectual heads, I assume a basic weak meaning and derive additional components of the meaning as grammatically generated implicatures. In a way to be made precise in the following section, I assume that UPs trigger alternatives that make assertions about both smaller intervals (subdomains) and larger intervals (superdomains), but that they lack a stronger universal alternative. The attested implicatures are then generated when exhaustification applies in different logical environments.

In UE environments, subdomain alternatives are stronger than the basic meaning. Exhaustification will lead to the inclusion (assertion) of these alternatives which derives strengthening that is analogous to FC and gives rise to Mittwoch’s condition restricting UPs to [+subinterval] predicates. Under negation, since entailment relations are reversed, the subdomain alternatives are entailed and no FC strengthening is generated. The superdomain alternatives, however, are stronger. Exhaustification thus leads to their exclusion (negation) which generates the AI.

4. Technical implementation

In this section, I attempt a unified semantic analysis for *until* phrases (UPs) that accounts for the data in the previous sections, and meets the challenge expressed in (10).

As a general framework, I will assume that sentences are evaluated relative to an index parameter (represented with the variable $i$) that is a pair of a world and a time $\langle w_i, t_i \rangle$. The intension of a sentence is a function from world-time pairs to truth values. I will also assume that tenses are Priorian quantificational operators. In the entry in (14), $PAST$ is a two-place operator that comes with a covert contextual restrictor argument (Ogihara, 1995; a.o.), and is also encoded with a non-emptiness presupposition (von Fintel and Heim, 2016).

\begin{equation}
\lambda m: \text{is a moment of time, } \lambda j. t_j \in \{t' | t' \text{ is before } m\}
\end{equation}

(14) For any $i$, $[[PAST]]^i_g = \lambda r: \exists t < t_i \& r(\langle w_i, t \rangle) = 1]$

\begin{equation}
\lambda q. \exists t \prec t_i \& r(\langle w_i, t \rangle) = 1 \& q(\langle w_i, t \rangle) = 1]
\end{equation}

4.1. Until as a modifier of tense

With the entries in (15) and (16), I propose an analysis of *until* phrases (UPs) as temporal modifiers of type $<s, t>$ that adjoin to the first argument of tense (which will be realized in the syntax as a silent type $<s, t>$ pronoun) and will combine via predicate modification.

\begin{equation}
[[\text{until}]]^i_g = \lambda m: \text{is a moment of time, } \lambda j. t_j \in \{t' | t' \text{ is before } m\}
\end{equation}

(15) $[[\text{until}]]^i_g = \lambda m: \text{is a moment of time, } \lambda j. t_j \in \{t' | t' \text{ is before } m\}$

\begin{equation}
[[\text{until 9}]]^i_g = \lambda j. t_j \in \{t' | t' \text{ is before 9}\}
\end{equation}

(16) $[[\text{until 9}]]^i_g = \lambda j. t_j \in \{t' | t' \text{ is before 9}\}$

To form the UP, *until* combines with an expression that denotes a moment of time and sets this time as the right boundary of the *until* time span (UTS). The left boundary is not specified within the UP but will be effectively set to the left boundary of the restrictor argument of tense. This is because the UP time is intersected with the the restrictor time via PM. Any parts of the UP time that stretch before this left boundary then do not enter the truth conditions.
Effectively, a UP restricts the first argument of the quantificational tense by providing a specific right boundary.

In this system, UPs are treated like frame adverbials in that they uniformly assert that the evaluation time is contained within the UTS. This means that aspectual heads specify the containment relation of the event time relative to the evaluation time, but unlike I&Z’s proposal, do not affect the containment relation relative to the UTS. The aspectual and lexical predicate entries are given below.

(17) a. $[[PFV]]^{i,g} = \lambda P_{(v,t)}. \exists e [e \text{ occurs in } w_i \wedge \text{Run}(e) \subseteq t_i \wedge P(e) = 1]$

b. $[[IMP]]^{i,g} = \lambda P_{(v,t)}. \exists e [e \text{ occurs in } w_i \wedge \text{Run}(e) \supseteq t_i \wedge P(e) = 1]$

(18) $[[\text{leave}]]^{i,g} = \lambda x \lambda e. e \text{ is an event of } x \text{ leaving.}$

To see how the pieces combine, consider the discourse in (19) and the LF for A’s response in (20).

(19) Q: What did Hana do on September 3rd, 2019?
   A: #Hana left until 9.

(20) \[
\begin{array}{c}
\text{TP} \\
\text{T} \\
\text{PAST} \\
\text{R} \\
\text{AspP} \\
\text{PFV} \\
\text{VP} \\
\text{Hana} \\
\text{leave} \\
nine \\
\text{until} \\
\end{array}
\]

Assuming that the context for (19) supplies the assignment function $g_c$, the value of the type $<s,t>$ tense restrictor pronoun is given in (21), and the intension of (20) is given in (22).

(21) $[[C_{5}]]^{i,g_{c}} = g_{c}(5) = \lambda j. t_j \text{ is within Sept. 3 in } w_j$

(22) $[[\wedge(20)]]^{i,g_{c}} = \lambda i:
   \begin{array}{l}
a. \exists t [t \prec t_i \wedge t \text{ is within Sept. 3 in } w_i \\
& \wedge t \in \{t'|t' \text{ is before 9} \text{ in } w_i\}]. \\
b. \exists t [t \prec t_i \wedge t \text{ is within Sept. 3 in } w_i \\
& \wedge t \in \{t'|t' \text{ is before 9} \text{ in } w_i\} \\
& \exists e. [e \text{ occurs in } w_i \wedge \text{leave(e, Hana)} \wedge \text{Run(e) } \subseteq t ]
   \end{array}$

At this point, the definedness and truth conditions in (22) don’t explain the infelicity of A’s utterance in (19). It simply states that Hana left at some point before nine on September 3rd. The following section will derive the infelicity as the result of an obligatorily strengthening of the meaning in (22) that will contradict world knowledge.

---

5This closely follows the implementation and discussion of tempreal contextual restrictors in (von Fintel and Schwarzschild, 2016) (class notes).

6For concreteness I use the $\wedge$ operator to generate the intension of (20) which will be fed to the EXH operator, but this is not a crucial choice.
4.2. Strengthening

4.2.1. Subdomain alternatives

Following Chierchia (2013)’s analysis of polarity sensitive items and I&Z, I assume that \textit{until} invokes subdomain alternatives. These alternatives are given in (23).

\begin{equation}
\text{Alt}((20)) = \{ \lambda i. \exists t_1 < t_2 : t \text{ is within Sept. 3 in } w_i \&
\text{t is within the interval } t' \text{ in } w_i \&
\exists e \text{ occurs in } w_i \land \text{leave}(e, \text{Hana}) \land \text{Run}(e) \subseteq t \mid t'' \subseteq \{ t' \mid t' \text{ is before 9} \}\}
\end{equation}

These alternatives are the set of propositions that are created by substituting the original UTS interval of the assertion with its different subintervals.

4.2.2. Exhaustification

An exhaust operator (EXH) then applies (obligatorily cf. Magri (2009)). For concreteness, I assume the EXH from Bar-Lev and Fox (2017) in (24). This derives free choice inferences in a similar manner to the EXH in Fox (2007). The addition of the notion of inclusion, however, allows it to generate the inferences with a single application, rather than the recursive applications required by the operator in Fox (2007).

\begin{equation}
a. \quad [(\text{EXH})^{\lambda g}]^{\lambda f} = \lambda A_{(st,t)}, \lambda p_{(st,t)}. \forall q \in \text{IE}(p, A)[\neg q(\langle w_i, t_i \rangle)]
\land \forall r \in \text{II}(p, A)[r(\langle w_i, t_i \rangle)]
\end{equation}

b. Given a sentence \( p \) and a set of alternatives \( A \):

(i) \( \text{IE}(p, A) = \bigcap \{ A' \subseteq A : A' \text{ is a maximal set in } A, \text{s.t.} \}
\neg q : q \in A' \} \cup \{ p \} \text{ is consistent} \)

(ii) \( \text{II}(p, A) = \bigcap \{ A'' \subseteq A : A'' \text{ is a maximal set in } A, \text{s.t.} \}
\{ r : r \in A'' \} \cup \{ p \} \cup \{ \neg q : q \in \text{IE}(p, A) \} \text{ is consistent} \)

Here, EXH takes as arguments a prejacent \( p \) and set of alternatives \( A \) and returns the negation of all IE alternatives, as well as the assertion of all the II alternatives. The IE alternatives are those that can be negated consistently without contradicting the prejacent, and without making arbitrary choices (thus each IE alternative must be in all the maximal sets). The II alternatives are those that can be asserted without contradicting the prejacent and without contradicting the negated IE alternatives (and also each must be in all the maximal sets).

Following work that extends free-choice analyses to different domains (Bowler, 2014; Bar-Lev and Margulis, 2014; Meyer, 2015; Bassi and Bar-Lev, 2016; Singh et al., 2016, a.o.), I assume that \textit{until} lacks a stronger universal alternative (something like ‘throughout the interval that extends to 9’). This creates a space of alternatives that is not closed under conjunction, which is the property that allows for strengthening that yields free-choice via EXH (Fox 2007).

4.2.3. Effects of EXH in UE sentences

In upward-entailing (UE) sentences, application of EXH leads to strengthening. The LF for (25a) is given in (25b). EXH takes the prejacent in (26) as an argument, and focus-associates with the UP to determine the alternative set \( A \). Considering a toy model in which the basic UTS interval consists of three subintervals, the alternative set is given in (27) (with formulas abstracting away from intensions and past shifting for ease of readability). They are also
sketched graphically on the timeline in (28).7

(25) a. # Hana left until nine
    b. [ EXH_A [Hana left [until nine]] ]

(26) Prejacent proposition:
\[ \lambda i. \exists t (t < t_i \text{ & } t \text{ is within Sep 3 & } t \in \{t' \mid t' \text{ is before 9} \} \text{ & } \exists e. [e \text{ occurs in } w_i \wedge \text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t]] \]

(27) Alt. set A:
\[ \{ \exists t \text{ within } [12, 7] \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t], \exists t \text{ within } [7, 8] \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t], \exists t \text{ within } [8, 9) \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t] \} \]

(28) Assertion UTS and subdomains:

In the timeline above, the largest brace that encompasses the entire timeline represents the UTS of the prejacent assertion in (26) spanning from the beginning of Sep 3rd to 9am. The three subintervals are marked by the three smaller braces. Here, the space of alternatives is analogous to free choice disjunction in the sense that **no subdomain alternatives will be IE**. It is easy to see that they all cannot be excluded without contradicting the assertion. Excluding any two alternatives would arbitrarily include the other one. Thus, none are in all maximal sets.

**All of the alternatives, however, are II and are asserted.** As shown in (29b), there is one maximal set that can all be asserted without contradiction, and this is the set of II alternatives. Similar to how the disjunctive alternatives are asserted in the case of FC disjunction giving rise to a conjunctive meaning, \( \exists \) strengthens to \( \forall \) quantification over subintervals with *until*. This strengthened assertion (the ‘subinterval implicature’) is the output of EXH given in (29c).

(29) a. IE = \( \emptyset \)
    b. II = \( \{ \exists t \text{ within } [12, 7] \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t], \exists t \text{ within } [7, 8] \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t], \exists t \text{ within } [8, 9) \text{ & } \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t] \} \)
    c. Output of EXH (the conjunction of the prejacent and II alts. above):
\[ \forall t. t \text{ within } [12, 9) \rightarrow \exists e. [\text{leave}(e, \text{Hana}) \wedge \text{Run}(e) \subseteq t] \] (subinterval implicature)

This strengthened meaning is now incompatible with world knowledge about leaving. Here, no logical contradictions are generated (as I assume an EXH operator that is contradiction free), but deviant sentences can arise if they clash with extra-grammatical knowledge about how the world works (leaving doesn’t happen repeatedly throughout an interval). This brings the account closer in spirit to Mittwoch’s intuition that the starred examples like (25a) are “not really

7For current purposes, I will assume a domain of intervals that is not dense. See Gajewski (2009) for a discussion of EXH’s interaction with dense domains. While a full discussion of these issues is beyond the scope of this paper, I will point out that free choice readings are available when quantifying over temporal domains in sentences like ‘You’re allowed to leave any time.’ Thus, it will be desirable for EXH-based accounts of FC-type inferences to be formulated in a way that is consistent with quantification over intuitively dense domains like times.
ungrammatical, but merely pragmatically odd” (Mittwoch, 1977). When a parallel derivation applies to (30), the sentence is fine, as *sleep* is compatible with the subinterval implicature.

(30) Hana slept until nine.

4.2.4. EXH in DE sentences

When a matrix EXH applies to a negated sentences as in (31), all subdomain alternatives are entailed and they have no effect (no problematic implicature is generated). It is simply the negation of the basic meaning.

(31) a. Hana didn’t leave until nine
   b. EXH$_A$[ NEG [Hana left [until nine]$_F$ ] ]

(32) a. Prejacent:
   \[\lambda i. \neg \exists t [ t < t_i \& t \text{ is within Sep } 3 \& t \in \{ t' \mid t' \text{ is before } 9 \} \& \exists e.[e \text{ occurs in } w_i \& \text{leave(e, Hana)} \& \text{Run(e)} \subseteq t] ]\]
   b. Alt. set A (simplified for readability):
   \[\{ \neg \exists t \text{ within } [12, 7) \& \exists e.[\text{leave(e, Hana)} \& \text{Run(e)} \subseteq t] ,
   \neg \exists t \text{ within } [7, 8) \& \exists e.[\text{leave(e, Hana)} \& \text{Run(e)} \subseteq t] ,
   \neg \exists t \text{ within } [8,9) \& \exists e.[\text{leave(e, Hana)} \& \text{Run(e)} \subseteq t] \}\]

Globally weaker readings (e.g., the reading of (33a) where Charlie was asleep but woke up at 8) can be derived with EXH embedded under negation (as in (33b)). In these cases, the strengthening proceeds as it does for the parse in (25b), and then this enriched meaning is negated.

(33) a. Charlie wasn’t asleep until nine.
   b. NEG [EXH$_A$ [Charlie was asleep [until nine]$_F$ ] ]

This also brings the current analysis in line with Mittwoch’s scopal account with a key modification that the various readings of (33a) are not the result of different scopal relations between negation and the UP but between negation and an EXH operator.$^8$$^9$

4.3. Deriving the actuality inference (AI) contrast with superdomain alternatives

To explain the contrast in (34a-b) observed by Karttunen (1974), I will assume that *until* also triggers superdomain alternatives.$^{10}$.$^{11}$.

(34) a. Hana didn’t leave until 9... #I don’t know if she left later.
   b. Hana was home until 9... I don’t know if she left later.

These alternatives are the set of propositions that are created by substituting all of the different larger intervals that contain the original UTS interval of the assertion. The alternatives of (34b)

---

$^8$Thank you to Luka Crnič (p.c.) for pointing out this connection.

$^9$I&Z’s analysis also uses embedded EXH for not-throughout readings, but in their case EXH applies vacuously to rescue negated PPI imperfectives modified by a UP.

$^{10}$These are similar to the scalar alternatives assumed in Condoravdi (2008), but which are applied only to NPI *until* within a lexical ambiguity analysis.

$^{11}$See also Chierchia (2013) for a brief discussion of the consideration of superdomain alternatives in the context of NPI *any.*
uttered in the same context as (19), for example, are given in (35).

\[
\text{Alt}^{\text{super}}(34b) = \\
\{ \lambda i. \exists t_i < t_i : t \text{ is within Sep 3 in } w_i \& \\
t \text{ is within the interval } t'' \text{ in } w_i \& \\
\exists e [e \text{ occurs in } w_i \& \text{be home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t ] \mid \\
t'' \supseteq \{ t' \mid t' \text{ is before 9} \} \}
\]

Note that because each substitution of the UTS is conjoined with the contextual restriction, only larger intervals that extend beyond the right boundary (past nine) on September 3rd are considered. Any times that extend to the left before Sep 3 are filtered out.

4.3.1. EXH of superdomain alts. in UE sentences

Consider the same toy model as the previous section extended to contain two superdomain alternatives. As noted before, the contextual restrictor filters out any times before Sept 3, so the two superdomain intervals will start at the same time as the original UTS and stretch beyond the right boundary. As shown in the timeline below, the original UTS stretches to 9, and the superdomain intervals stretch to 10 and 11 respectively.

(36) Superdomain alternatives:

With matrix EXH applied to UE sentences like (37), no subdomain alternatives in (38b) are IE, but all are II and derive the subinterval implicature in (38d) (just as with (25b)). The superdomain alternatives in (38c) are entailed and are vacuously II and have no effect. Nothing new is asserted about the times after nine, and the continuation in (34b) is fine.

(37) EXH

\[ A \quad [\text{Hana was home [until nine]}] \]

(38) a. Prejacent:
\[ \exists t \text{ within [12, 9]} \& \exists e. [\text{be home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t] \]

b. Alt. set A (subdomain):
\[ \{ \exists t \text{ within [12, 7]} \& \exists e. [\text{be home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t], \\
\exists t \text{ within [7, 8]} \& \exists e. [\text{at home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t] \}, \\
\exists t \text{ within [8, 9]} \& \exists e. [\text{at home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t] \} \]

c. Alt. set A (superdomain):
\[ \{ \exists t \text{ within [12, 10]} \& \exists e. [\text{be home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t], \\
\exists t \text{ within [12, 11]} \& \exists e. [\text{be home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t] \} \]

d. Output of EXH
\[ \forall t. t \text{ within [12, 9]} \rightarrow \exists e. [\text{at home}(e, \text{Hana}) \land \text{Run}(e) \supseteq t] \]

4.3.2. EXH of superdomain alts. in negative sentences generates AI

With matrix EXH applied to negated sentences like (39) the subdomain alternatives are entailed as illustrated in (40b). The superdomain alternatives shown in (40c), however, are stronger than the prejacent. These are IE and are negated, deriving the implicature that Hana left in the smallest superdomain (at the border of the UTS). The conjunction of the prejacent with the
negation of the IE alternatives is shown in (41).

(39)  a. Hana didn’t leave until nine.
       b. EXHₐ [NEG [Hana left [until nine]₉] ]

(40)  a. Prejacent:
       ¬∃t within [12, 9) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t]
       b. Alt. set A (subdomain):
           { ¬∃t within [12, 7) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t],
             ¬∃t within [7, 8) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t],
             ¬∃t within [8,9) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] }
       c. Alt. set A (superdomain):
           { ¬∃t within [12, 10) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t],
             ¬∃t within [12, 11) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] }

(41)  Output of EXH
       a. Prejacent:
           ¬∃t within [12, 9) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] ∧
       b. Negation of IE alternatives:
           ¬¬∃t within [12, 10) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] ∧
           ¬¬∃t within [12, 11) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] =
       c. ¬∃t within [12, 9) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t] ∧
           ∃t within [12, 10) & ∃e.[leave(e, Hana) ∧ Run(e) ⊆ t]

The enriched meaning in (41c) explains the infelicity of the continuation in (34a) with the added assumption that the implicatures generated are obligatory. I propose that these implicatures are not cancelable because until requires exhaustification, and I assume a condition that prohibits vacuous application of EXH (Spector and Sudo, 2017, Fox and Spector, 2018).  

4.4. What polarity sensitivity reveals about the syntax of UPs

I also note that crucial to deriving the correct AI is having superdomain alternatives that extend only past the right boundary of the original UTS. This is what derives an AI that happens right at the right boundary. If they also extended to the left, an AI could be derived that occurs at some time before the original UTS, contrary to the attested inference. This is a key motivation for the syntax assumed here in which the UP is adjoined to the contextual restrictor C (argument of tense) rather than serving as the first argument itself. This makes it possible to understand the alternatives as supersets and subsets of the original interval. Also, assuming that the full set of alternatives is created by simply substituting different values for the right boundary wouldn’t create subdomain alternatives rich enough to generate the subinterval implicature. This is because they would all be entailed by the alternative with the smallest subinterval in UE sentences, and would thus not be includable. With this option untenable, the simplest way to

12While EXH of UPs can’t be vacuous, I do assume that some coarseness is allowed in the implicature calculation in both the positive and negative cases. Thus, (ia) only requires blinking events during intervals of a contextually relevant size, and (ib) allows the marriage event to follow the meeting in only the smallest contextually relevant interval, not the instant they met. Reasons of space prevent further discussion of this important issue.

(i)  a. Katy blinked until her eyes adjusted to the new level of darkness.
       b. Nancy didn’t marry until she met Henry.  (Karttunen)
filter out intervals that stretch before the left boundary is to assume an intersection with C.

This also has the benefit of unifying the syntax of UPs with the syntax for the canonical PSI *any*. As illustrated in (42)\(^{13}\), the constituent responsible for the alternatives that generate polarity sensitivity are uniform across constructions, as they are both restrictors of the first argument of their respective quantifiers. For *any*, this is the domain restrictor variable \(D\) (Chierchia, 2013), and for UPs, it is the UP itself that restricts the first argument of the quantificational tense. The alternatives generated in both cases can be viewed as alternate values for this element.\(^{14}\)

\[(42)\]

\[
\begin{array}{c}
TP \\
\hspace{1cm} \text{PAST} \\
\text{T} \\
\hspace{1cm} \text{R} \\
\hspace{1cm} \text{C} \\
\text{AdvP}_F \\
\text{until nine}
\end{array}
\quad
\begin{array}{c}
TP \\
\text{AspP} \\
\text{Hana leave} \\
\text{any} \\
\text{NP} \\
\text{student} \\
\text{D}_F \\
\text{left}
\end{array}
\]

4.5. Interim summary

In this account, UPs are uniformly associated with strengthening in all logical environments. The structure of the alternatives gives rise to different implicatures in positive vs negative environments, which derives the core properties of UPs that have been discussed in the literature. In positive environments, there is an obligatory subinterval implicature, and in negative cases, an obligatory AI. Infelicity results when these implicatures contradict contextual knowledge.

4.6. Independent motivation for alternatives

The present analysis relies on the assumption that UPs invoke subdomain and superdomain alternatives. These alternatives would not have to be stipulated if this could be made to follow from a more general algorithm of alternative generation. This section will sketch a path towards doing this by using the independently-motivated proposal for generating formal alternatives in Katzir (2007). A summary of Katzir’s algorithm is given in (43).

\[(43)\]

Formal alternatives (Katzir, 2007)
\[
\text{ALT}(S) = \{S' \mid S \text{ can be transformed into } S' \text{ by a finite series of deletions, contractions, and replacements of lexical items with lexical items of the same category}\}
\]

Using the formula in (43), the alternatives of a sentence modified by a UP will be the set of all sentences that are generated by replacing the UP with other possible constituents of equal or lesser complexity that denote propositions (which will be intersected with the contextual restrictor \(C\)) as in (44).\(^{15}\)

---

\(^{13}\)I assume that some operation is needed to generate the sentence-final word order of the UP, possibly extraposition. An alternate possibility attributed to Mitya Privoznov in von Fintel, K. and I. Heim (2016) (class notes), is that the tense head takes its arguments in the opposite order. Although this breaks the analogy with *any* in terms of linear order, the unification remains on a structural level. More work is needed to determine the right approach.

\(^{14}\)The idea that temporal adverb PSIs and *any* are unified in both triggering domain alternatives is already present in Chierchia (2013) and I&Z. The suggestion here is explicitly extending this parallel to the syntax as in (42).

\(^{15}\)This closely follows Crnič (2019)’s proposal for a principled approach to generating alternatives for polarity...
4.6.1. Sets of alternatives not previously discussed

In addition to the subdomain and superdomain intervals that were shown to generate the attested implicatures in the previous section, there will also be additional types of alternatives generated by Katzir’s algorithm. For example, there will be those in which the UTS is an interval that overlaps with the original UTS but is not a subinterval or superinterval as illustrated below. These alternatives would be II in UE sentences and IE in DE sentences but would not add anything new to the overall meaning.

(45) Overlapping alternatives:

Sep 3, 12am 8am 9am 10am

There would, however, also be alternatives in which the UTS is disjoint with the original UTS of the assertion as illustrated in (46).

(46) Disjoint alternatives:

Sep 3, 12am 9am 10am 11am

These will be IE in both positive and negative sentences and will derive additional implicatures. In positive sentences, excluding (negating) these alternatives will derive an implicature that there is no time after the UTS in which the sentence is true. This is not a bad result for sentences like (47) which intuitively do imply that Hana was not home after nine. The continuation in (47b), however, indicates that this implicature is cancelable.

(47) a. Hana was at home until nine.
       b. ... I don’t know if she left after.

In negative sentences, the result of excluding alternatives with intervals disjoint from the UTS leads to a pathological result. In (48), for example, this would lead to the implicature that Hana did leave in every interval after nine. This is clearly unattested and would have to be canceled.

(48) Hana didn’t leave until nine.

sensitive any. An important difference, however, is that the constituent being substituted with any is a domain restrictor pronoun, while with UPs it is a syntactically complex phrase. A more fleshed out discussion of lexical substitution that takes into consideration the internal complexity of UPs is left to future work.
The remainder of this subsection will sketch a way to understand why some of the generated inferences are cancelable, and others are not.

4.6.2. Constraints on pruning

Within an exhaustification framework, it is often assumed that alternatives that are not relevant can be ignored (pruned), and thus certain implicatures will not be generated. This being the case, the alternatives that contain UTS intervals that are disjoint with the assertion UTS could be generated in accordance with Katzir’s algorithm but deemed irrelevant and pruned. The challenge then is in explaining why the alternatives that generate the subinterval implicature and the AI are obligatory and can’t be pruned, while these other disjoint alternatives can.

To capture the attested facts, I will assume that pruning is in general possible, but it is limited in systematic ways. Following work by Katzir (2014), Bar-Lev and Fox (2017), Crnić (2019), I assume that only IE alternatives can pruned (see the aforementioned work for motivation and technical implementation). This means that the subinterval implicature in the positive cases is obligatory even when it leads to pathological results since it is the result of II alternatives.

The rest of the implicatures discussed are the result of negating IE alternatives. The AI in positive sentences (like the one that implies that Hana was not home after nine in (47a) for example) results from IE alternatives, so it is cancelable. Like many implicatures, however, a specific context and an explicit cancelation like the continuation like in (47b) is required to do so, which conforms to what is known about context-sensitive implicatures in general.

In negative sentences, the pathological implicature that states that the sentence is true within every time after the UTS (like the one that asserts that Hana left at all times after nine in (48)) is also the result of IE alternatives. This means these can be pruned. And, since the implicature is pathological, it seems reasonable that this does not require explicit cancelation.

In negative sentences, there is also the implicature that generates the AI. This is derived through negating the IE superdomain alternatives. I will suggest that this implicature is obligatory since pruning all of the superdomain alternatives would lead to a vacuous application of EXH. This is the essential difference between (49a) and (49b). In (49a), the negative case, pruning the alternatives responsible for the AI would lead to vacuous EXH. In (49b), however, pruning the IE alternatives in the positive case does not result in vacuous EXH, as in those cases EXH strengthens the assertion by asserting the II alternatives and deriving the subinterval implicature.

(49)  

a. Hana didn’t leave until 9... #I don’t know if she left later.  
b. Hana was home until 9... I don’t know if she left later.

While banning vacuous EXH is a stipulation, independently-motivated economy conditions have been proposed to this effect (Spector and Sudo, 2017; Fox and Spector, 2018). Also, thinking of polarity-sensitivity in this way constitutes a potential conceptual advantage over systems of polarity sensitivity based on Chierchia (2013) in which exhaustification of PSIs can derive logical contradictions. This is because in this system, NPIs are grammatical only when EXH is semantically vacuous which is arguably unintuitive from the perspective of economy principles.
5. Extensions: Towards an explanation of until’s stronger licensing conditions.

It is known that UPs have stricter licensing conditions than NPI any. While any is good in (merely) Strawson DE environments, UPs modifying [-subinterval] VPs are not (Gajewski, 2011; Chierchia, 2013; a.o.). This is evident, for example, in the scope of DE factives, conditional antecedents, and restrictors of universal and negative quantifiers:

(50)  
  a. Noah is unaware that Bill fell asleep at any time during the talk.
  b. *Noah is unaware that Bill fell asleep until 9.

(51)  
  a. If Charlie leaves on any Tuesday, he will get a discount.
  b. *If Charlie leaves until tomorrow, he will miss Hana’s talk.

(52)  
  a. Every/no student that left during any of the talks experienced problems.
  b. *Every/no student that left until yesterday experienced problems.

Since my analysis of UPs relies on an exhaustification mechanism that is sensitive to entailment, as it currently stands, UPs modifying [-subinterval] predicates are predicted to be good in the Strawson DE environments in (50)-(52) above, contrary to fact. An additional mechanism, then, is needed to explain why these are unacceptable. The following work by Marty and Romoli (2020) (M&R) indicates that an independently-needed mechanism could explain these facts.

5.1. Presupposed free choice (Marty and Romoli, 2020)

M&R (building on Gajewski and Sharvit, 2012; Spector and Sudo, 2017; a.o.) note that free choice (FC) implicatures show up in the presupposition of Strawson DE factives:

(53)  
  a. Noah is unaware that Olivia can take Logic or Algebra.  
    b. *Noah doesn’t believe that Olivia can take either one.  
    c. Olivia can take Logic and can take Algebra.  
   (M&R)  
    a. PRES FREE CHOICE

In (53), there is no strengthening in the DE assertion in (53a), but the strengthened FC inference appears in the UE factive presupposition in (53b). As the present analysis of UPs has an analogous logical structure to free choice, I suggest that it is now possible to understand the badness of (54) in analogy to (53).

(54)  
  *Noah is unaware that Bill fell asleep until 9.  (~~Presup: Bill fell asleep until 9.)

Assuming that UPs strengthen in UE presuppositions similar to the inferences discussed by M&R, these inferences would lead to presuppositions that contradict contextual knowledge. A hope is that this reasoning could generalize to derive Gajewski (2011)’s licensing condition that strong NPIs are unacceptable in DE environments with intervening UE presuppositions. This would follow if strengthening shows up in these presuppositions as well, as indicated in (55).

(55)  
  a. *If Charlie leaves until tomorrow, he will miss Hana’s talk.
  b. UE Presupposition: It is possible that Charlie will leave until tomorrow.

(56)  
  a. *Every/no student that left until yesterday experienced problems.
  b. UE presupposition: There exists a student that left until yesterday.

Additional work is needed to develop the technical details of how these inferences are gener-
ated within the broader context of the interaction of presuppositions. The data above, however, indicates that *until*’s licensing conditions in these environments can be reduced to the phenomena discussed by M&R, once it is understood that free choice disjunction and UPs share similar underlying features to the exclusion of ‘weak’ NPIs.\(^{16}\)

In more formal terms, I hypothesize that since *until*’s subdomain alternatives are II in UE environments, they are asserted in the UE presupposition of other operators. These presuppositions then yield clashes with extra-grammatical knowledge in the relevant cases. NPI *any*’s domain alternatives, however, are neither IE nor II in unembedded UE environments. Thus, they are neither obligatorily asserted nor negated in the UE presupposition of other operators and don’t yield problematic inferences.\(^{17}\)

6. Open Issues and conclusion

6.1. The ‘Beyond Expectation Inference’ (BEI)

Previous work on *until* (Karttunen, 1974; Condoravdi, 2008; I&Z; a.o.) attributes negated *until* not only with an obligatory AI but an additional inference that the eventuality that the UP modified happened later than expected. The following is from I&Z:

\[
\begin{align*}
(57) & \quad \text{a.} \quad \text{I expected her to arrive at 5pm but she didn’t arrive until 7pm.} \\
& \quad \text{b.} \quad \#\text{I expected her to arrive at 5pm but she didn’t arrive until 3pm.}
\end{align*}
\]

As it stands, my account does not directly derive a BEI. There is, however a suggestive connection with the use of *only* in (58) below.\(^{18}\)It is know that *only* can give rise to inferences about scales of expectation (cf. Beaver and Clark, 2009; a.o.). And since EXH is often argued to be a type of covert version of *only*, it is perhaps not surprising that obligatorily exhaustified sentences exhibit similar effects. Developing this connection further is left to future work.

\[
\begin{align*}
(58) & \quad \text{a.} \quad \text{I expected her to arrive at 5 but she only arrived at 7.} \\
& \quad \text{b.} \quad \#\text{I expected her to arrive at 5 but she only arrived at 3.}
\end{align*}
\]

6.2. Concluding remarks

The analysis in this article follows Mittwoch and I&Z in insisting on a unified semantics for UPs and also builds on many of their insights. I argue, however, that their analyses face some empirical problems. Mittwoch’s analysis is unable to derive the contrast in actuality inferences in positive vs negative sentences (as pointed out by Karttunen), and I&Z’s analysis incorrectly predicts ungrammaticality for some perfective activity VPs.

My proposal relies on assuming that UPs have important formal similarities with free choice. Within a framework that generates implicatures with exhaustification, the core properties of UPs are shown to fall out as the result of the assumed space of alternatives, and its similarity to FC. The full range of alternatives considered causes UPs in positive sentences to strengthen

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\(^{16}\)See I&Z for a different explanation of *until*’s sensitivity to intervening presuppositions that relates it to the idea that for Strong NPIs like *until*, the existence of the domain (the UTS) is presupposed rather than asserted. A full discussion and comparison of this idea with the one suggested here is left to future work.

\(^{17}\)Another point of contrast is that a presupposed universal (FC) reading for *any* would not necessarily contradict contextual knowledge the same way it does for [-subinterval] VPs modified by a UP.

\(^{18}\)thank you to Luka Crnič (p.c.) for pointing out this parallel. See also Giannakidou (2002); Condoravdi (2008); I&Z for the comparison to Greek *para mono* (but only).
in such a way as to be incompatible with predicates that don’t have the subinterval property and those under negation to derive an actuality inference. The formal similarities to FC is also shown to have promising consequences for understanding UPs’ interactions with presuppositional elements, in light of recent work on interactions between presupposition and implicature.

The analysis presented here also raises questions about what role the mechanisms that derive the properties of UPs play in other temporal adverbs. A general theory will have to explain why some adverbs have these properties and some don’t.19 The logic of this account suggests that it should follow from the semantics and alternatives attributed to each item as well as their obligatory vs optional interaction with EXH.20 In future work, I hope to not only explore these challenges but investigate whether similar pragmatic approaches can help to explain the properties of durational adverbs (for an hour) and the in years class of polarity sensitive adverbials.

References


19Thank you to Anastasia Giannakidou, p.c. for raising this important point.

20Thank you to a Sub reviewer for raising the question of motivation for the stipulated alternatives.
Abstract. Although widely discussed in the semantics literature, donkey sentences have been the subject of very little experimental study. In this paper, we present experimental work that is aimed at addressing somewhat open questions around donkey sentences with determiners other than ‘every’ and their susceptibility to both Universal and Existential readings. Our experiments test donkey sentences with ‘every’, ‘no’, ‘some’ and ‘more than two’. By using both verification and act-out tasks, we are able to show that Universal readings are available for donkey sentences with existential determiners (specifically, ‘more than two’), as well as Existential readings. However, our studies fail to show that sentences with ‘no’ have a Universal reading, and they also provide some evidence against the idea that ‘no’ sentences have dual readings.

Keywords: donkey sentences, truth value judgments, act-out task

1. Introduction

Singular donkey sentences are widely recognised as being susceptible to several kinds of construal (Chierchia, 1995; Kanazawa, 1994; 2001; Geurts, 2002; Brasoveanu, 2008). Informants often report an intuition that there is a uniqueness implication. For (1), this would mean that each girl who baked a cake, baked one cake. However, informants are also prepared to accept that a sentence such as (1) could be used to describe a scenario where girls bake more than one cake. In that case, it has been observed that sometimes intuition prefers a so-called Universal reading. For (1), this would be that every girl who baked a cake iced all of the cakes she baked. However at other times, the preference is for an Existential reading. For (1), that would be that each girl who baked cakes ices some of the cakes they baked.

(1) Every girl who baked a cake iced it.

Given the widely accepted duality of readings for donkey sentences with ‘every’, a variety of proposals have been made to explain how these readings can be derived. Many such proposals entail that donkey sentences headed by determiners other than ‘every’ should also give rise to both E- and U-readings. However, it is widely recognised that intuitions do not clearly support this prediction nor indeed is it clear the extent to which donkey sentences might have clear, determinate readings in the first place (Rooth, 1987; Kanazawa, 1994; Chierchia, 1995; a.o.). To date, very little literature has systematically explored intuitions about readings of donkey sentences with different determiners. The most widely discussed report on participant intuitions is Geurts (2002). The results of that paper provide clear-cut evidence for two readings for sentences with ‘every’ and ‘not every’, while results for sentences with ‘some’ and ‘no’ do not provide clear evidence for both. So, the question going forward is whether both readings are possible for these kinds of donkey sentence.

1 There is not scope in this paper to review these. An excellent and comprehensive overview can be obtained from sources such as Chierchia (1995), Brasoveanu (2008) and Champollion et al. (2018).
The primary aim of this paper is to explore the availability of readings experimentally. In particular, our aim is to compare the availability of E- and U-construals for donkey sentences with universal (‘every’), negative (‘no’) and existential (‘some’, ‘more than two’) determiners. Unlike previous experimental work on donkey sentences, we combine both truth-value judgement tasks (Experiment 1) and act out tasks (Experiment 2). Because of possible ambiguity in donkey sentences, we have to take account of strategies for responding to different tasks. Critical items in both of our tasks make one reading true and the other false. In a truth-value judgement task, to the extent that both readings are accessible to a participant, a critical item should get a ‘true’ rating (since the image makes the sentence true on one of its available readings). In an act out task, participants may trade off Caution against Laziness. To the extent that both readings are available, a cautious participant will make the stronger reading true (the one that entails the other). However, if a weaker reading is already true, a lazy respondent may leave things be. To summarise the results below, we find no evidence for two construals of donkey sentences with ‘no’, but good evidence for two construals of versions with ‘every’ and ‘more than two’. We conclude with a discussion of how to factor in the effects of context and determiner-specific strategies in accounting for why readings may be hard to find.

2. Experiment 1

2.1. Participants

43 participants were recruited from Prolific Academic and were paid 0.4 pound for their participation. All participants speak English as a native language. The experiment was initiated by a consent statement and was approved by the University College London Research Ethics Committee.

2.2. Materials and Procedure

We tested the availability of Universal and Existential readings for donkey sentences with four determiners: universal (‘every’), negative (‘no’) and existential (‘some’, ‘more than two’). For each determiner, we constructed three donkey sentences using three different scenarios: (i) girls baking and icing cakes; (ii) boys making and painting trains; and (iii) monkeys picking and peeling bananas. Each donkey sentence was paired with three types of displays: ‘true’ controls that made the sentence true on both readings, ‘false’ controls that made the sentence false on both readings, and target displays that made the sentence true on one of its available readings. Fig. 1 shows example sentences and displays for each determiner. One version of each item was assigned to one of the three lists, with each list containing 12 experimental items, 4 items per condition. In addition, each list contained 24 filler trials. Filler trials did not use donkey sentences. Half of the filler trials contained sentences with determiners, e.g. ‘every girl baked a cake’, and half contained simple positive/negative sentences, e.g. ‘The yellow girl baked/didn’t bake a cookie’. Participants were randomly assigned to one of three lists. A randomized order of presentation of the items was created for each participant.
2.3 Predictions

Before turning to results, it is important to consider what we might expect if a given donkey sentence has both Universal and Existential readings, or if it has only one kind of reading. If one takes the view that a donkey sentence, with a given determiner, is able to give rise to both readings, there are several scenarios that are possible in our experimental setting. It could be that, when the participant reads the stimulus sentence in a trial, both readings are available to them. To give an example of what might happen in this case, let us consider an example of simple ambiguity, from beyond the area of donkey sentence research. Suppose a participant were given a sentence like, ‘The woman walked toward a bank’ and shown either a picture of a woman approaching a branch of Bank of America on a typical main street, or a picture of a woman walking through a field toward a river bank. In both cases, the expectation is that the combination of the linguistic stimulus and visual stimulus ought to allow the participant to see that there is a parse of the sentence that can make it true, assuming that both possible lexical senses become available to them. Thus, in our study, assuming that both possible construals become available to a participant, we assume that a participant will judge the sentence as true if the accompanying image makes the sentence true on one of those available readings. This could be called a ‘charitable’ response.

However, what we know about lexical ambiguity is that under certain conditions, even if a word has two senses, a participant may only access one sense – this through a combination of sense frequency and contextual bias (see for example, Duffy et al., 1988). We assume that something similar could carry over to the case of a donkey sentence that has two possible readings: for a combination of factors, on a given trial, only one reading becomes available to the participants and they base their response on that.
The other kind of scenario is that the donkey sentence with a given determiner has only one reading (i.e. only a Universal reading or only an Existential reading) and participants base their response on that.

2.4 Results

The percentages of ‘true’ responses for each determiner and condition are shown in Fig. 2. The mean accuracy on control items was 96%. Only in the target condition of ‘every’, the percentage of ‘true’ responses differed significantly from both ‘true’ controls ($\chi^2(1) = 9.38, p = .002$) and ‘false’ controls ($\chi^2(1) = 35.8, p < .001$).

![Figure 2. Percentage of ‘true’ responses for each determiner and condition.](image)

2.5 Discussion

‘Every’: The fact that rate of ‘true’ in the target condition differs significantly from both the control conditions tells us that overall, participants did not find these sentences straightforwardly true or false in these cases. If ‘every’ donkey sentences only had an existential reading, we should expect rates to not differ from the ‘true’ control condition. If these sentences have only a universal reading, we would expect rates to not differ from the ‘false’ control condition. Thus, these results disconfirm the single-reading hypothesis for ‘every’ donkey sentences. In a way, this just confirms what is virtually universally agreed in the literature – that both readings are possible for the ‘every’ case. Another important observation to make here is that, assuming both readings are possible for these sentences, the existence of ‘false’ judgements means that, on some trials, only the U-reading is available. This
occurred in 37% of cases. So in these trials we have a situation of the kind mentioned above where, for reasons of frequency or due to contextual cues attended to in the trial, the E-reading does not become available.

‘No’: In the target condition of donkey sentences with ‘no’, the display made the U-reading true, yet the rates for target items did not differ from ‘false’ controls. This suggests either there is only the E-reading or that the U-reading is very inaccessible across virtually all of the trials.

‘Some’/‘more than two’: In the target condition of ‘some’ and ‘more than two’, the percentage of ‘true’ responses did not differ from ‘true’ controls. Since the display made the E-reading true, these results are of course consistent with the existence of only an E-reading for existential quantifiers. When considering other possible hypotheses, we should note that conditions for these trials differ from the ‘no’ case. In the ‘no’ case, participants virtually always responded ‘false’. In the case of existential determiners, the high rates of ‘true’ are consistent not only with a second, universal reading being completely unavailable or inaccessible, but also with the second reading being quite available. In the latter case, we have a situation as in the lexical ambiguity (‘bank’) case discussed above. It could simply be that with both readings available and an image consistent with one, participants respond ‘true’.

In order to tease apart these two scenarios with existential determiners, we turn to an act out task using basically the same sentences and scenarios.

3. Experiment 2

3.1. Participants

42 participants were recruited from Prolific Academic and were paid £0.7 for their participation. All participants speak English as a native language. The experiment was initiated by a consent statement and was approved by the University College London Research Ethics Committee.

3.2 Materials and Procedure

Participants were presented with a display containing four agents and four possible states of affairs. The checked radio button indicates the outcome of each agent’s activity. A fairy would give an instruction and the participants’ task was to make sure that the outcome is as the fairy wanted. The fairy’s instructions were constructed with four determiners: universal (‘every’), negative (‘no’) and existential (‘some’, ‘more than two’) determiners, an example sentence for each determiner is given in Table 1. As in Experiment 1, for each determiner, we constructed three donkey sentences using three different scenarios: (i) girls baking and icing cakes; (ii) boys making and painting trains; and (iii) monkeys picking and peeling bananas. Each statement was paired with three situations: ‘obligatory act’, ‘do nothing’, and ‘optional act’, as shown in Fig. 3.
Table 1. Example sentence for each determiner in Experiment 2.

<table>
<thead>
<tr>
<th>Determiner</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every</td>
<td>I would like it that every girl who baked a cake iced it.</td>
</tr>
<tr>
<td>No</td>
<td>I would like it that no girl who baked a cake iced it.</td>
</tr>
<tr>
<td>Some</td>
<td>I would like it that some girls who baked a cake iced it.</td>
</tr>
<tr>
<td>More than two</td>
<td>I would like it that more than two of the girls who baked a cake iced it.</td>
</tr>
</tbody>
</table>

Figure 3. Example situations for each determiner in Experiment 2.

In the ‘obligatory act’ situation, whether both readings or only one reading were available, participants need to change what an agent has done by clicking a radio button under the desired state of affairs. For instance, when the instruction is ‘I would like it that every girl who baked a cake iced it’, the image shows one girl as having baked two cakes but having iced none (see Fig.3 top left). If participants access the U-reading, they should change what this girl has done by clicking the radio button under the two iced cakes; whereas if they access the E-reading, they have a choice between clicking the radio button under either both iced cakes or one iced and one un-iced.

In the ‘do nothing’ situation, the image is such that, whether both readings are available, or only one, the participant need do nothing. Here, the image was compatible with the U-reading in the case of ‘every’, ‘some’, and ‘more than two’; and it was compatible with the E-reading in the case of ‘no’. If these readings are preferred, participants should leave the situation unchanged.
In the ‘optional act’ situation, the display was compatible with just one reading. As for the test condition in the verification task, the image was compatible with the U-reading in the case of ‘no’ and the E-reading in the case of ‘every’, ‘some’ and ‘more than two’.

One version of each item was assigned to one of the three lists, with each containing 12 experimental items, 4 items per condition. In addition, each list contained 24 filler trials. Filler trials did not use donkey sentences. Participants needed to change the display in half of the filler trials. Participants were randomly assigned to one of three lists. A randomized order of presentation of the items was created for each participant.

3.3 Predictions

As in the case of the verification task (Experiment 1), we should consider what could be expected, if a donkey sentence has just one (E- or U-) or two readings. For a given donkey sentence, if we assume that it is in principle possible for both readings to be available, then we still have a question whether both readings will become available on a given trial (due to effects of frequency, the stimulus etc.). Moreover, if both readings are available in a given trial, then what might a participant do? Given that, for each of our determiners, the two readings are ordered by entailment, we might expect that, if a participant exercises Caution, then they might base their response on the logically stronger reading. That way, whatever the fairy’s actual desire, they can be sure to have satisfied it. In that case, they will make any changes based on that. However, if two readings are available and the visual state of affairs is already consistent with one, then Economy of effort might come into play and the participant may leave the situation as it is.

3.4 Results

Obligatory act. 1.2% of the responses were excluded because participants’ responses resulted in a display that made the fairy’s statement false. 12% of the responses were removed because participants changed the distractor. In most such cases, participants changed the cookie to a cake. Though many such responses could still be evaluated (as being Existential or Universal) we felt that participants who responded this way may have misunderstood the sentence (e.g. as, ‘Every girl baked a cake and iced it’). Fig. 4 shows the percentages of U/E-responses for each determiner in the ‘obligatory act’ situation.
Figure 4. Percentages of U/E-responses for each determiner in the ‘obligatory act’ situation.

Optional act. 1.2% of the responses were excluded due to false choices. Again 8.9% of the responses were removed due to the change of the distractor. The status quo was compatible with the U-reading in the case of ‘no’, and it was compatible with the E-reading in the case of ‘every’, ‘some’, and ‘more than two’. Participants who preferred a different reading would make changes to the display. Fig. 5 shows the percentages of U/E-responses for each determiner in the ‘optional act’ situation.
Figure 5. Percentages of U/E-responses for each determiner in the ‘optional act’ situation.

**Do nothing.** 1.2% of the responses were excluded due to false choices. 4.8% of the responses were removed due to the change of the distractor. The status quo was compatible with the U-reading in the case of ‘every’, ‘some’ and ‘more than two’ and it was compatible with the E-reading in the case of ‘no’. Fig. 6 shows the percentages of act/no-act for each determiner in the ‘do nothing’ situation.

![Graph showing percentages of act/no-act for each determiner.](image)

Figure 6. Percentages of act/no-act for each determiner in the ‘do nothing’ situation.

3.5 Discussion and Further Analysis

‘Every’: The percentage of U-reading responses in the obligatory act condition was significantly higher than the chance level ($\chi^2 (1) = 14.24, p < .001$), whereas this percentage in the optional act condition did not differ from the chance level ($p = .18$). These results suggest that participants were ambivalent about the interpretation of the donkey sentences with ‘every’. If there was only a U-reading for these sentences we should expect optional and obligatory responses to not differ and to be overwhelmingly for the universal state. This is clearly not the case. We can see this by looking at the preference for ‘existential’ response (i.e. choice of radio button with just one iced cake) between the two conditions which marginally differ ($\chi^2(1) = 3.5, p = .06$). To further support a two-reading account, we can consider what an E-reading only hypothesis would predict. On that assumption, we would expect that for both optional and do nothing conditions, no action was required. Thus, any action performed by participants would be for reasons to do with a felt need to do something on a trial. That effect would be the same across conditions. However, rates of action across the two conditions differ markedly (57% vs. 0%).
Thus both act-out and verification results with these items reveal that both U- and E-readings are available when participants encounter ‘every’ donkey sentences. This bears out the finding in Geurts (2002). It is interesting to now consider the data from ‘every’ sentences in more detail to see if we can find evidence of Cautiousness and Economy in participants’ responses. If both readings are possible and available, then Cautiousness determines a strong preference for both-cakes-iced response on both optional and obligatory act. However, if both readings are possible and available, then Economy determines doing nothing on optional act (just-one-iced response). Thus if these two conflicting motivations are in operation for ‘every’ sentences, we would expect to find higher rates of U-reading in obligatory act than optional, and this prediction is borne out.

‘No’: Participants always preferred the E-reading consistent response (no cakes iced) both in the obligatory act condition (100%) and in the optional act condition (97%). We can easily rule out a hypothesis that says ‘no’ sentences only have a U-reading by noting that rates of action should be no different between optional act and no act conditions (97% vs. 0%). If ‘no’ sentences only have E-readings available, then we would expect both optional and obligatory conditions to result in E-reading outcomes above chance – which is the case. So, this study adds further support to the only E-reading hypothesis. In the verification study (Expt. 1), we saw an effective universal rejection of the U-reading state of affairs and this suggested either that these sentences only have an E-reading or that the U-reading was highly inaccessible. We can here further seek some evidence for the multiple reading hypothesis by considering whether we can observe a trade-off between Cautiousness and Economy in the obligatory and optional act trials. If so, we should see a lower rate of E-reading responses in optional act than obligatory, but this is not the case.

‘More than two’: In the obligatory act condition the percentage of two-iced cake responses was significantly higher than the chance level ($\chi^2 (1) = 8, p = .005$), whereas in the optional act condition the percentage of just-one-iced responses was significantly higher than the chance level ($\chi^2 (1) = 16, p < .001$). There is a clearly different pattern of responses here and this conflicts with a U-reading only view of ‘more than two’ sentences. As mentioned above, it has been suggested that donkey sentences with existential determiners only have E-readings (e.g. Kanazawa, 1994). However, this data speaks against an E-reading only view since in the obligatory act condition, the rate of two-iced responses should be same as rate of just-one responses. In fact these are markedly different (75% vs. 25%). In line with the ‘every’ donkey sentences, we see the expected pattern of trade-off between Caution and Economy in the ‘more than two’ case: more ‘universal’ responses in the obligatory act than optional. This pattern is predicted on two readings view of this kind of donkey sentence.

‘Some’: The percentage of just-one-iced responses was significantly higher than the chance level both in the obligatory act condition ($\chi^2 (1) = 5.77, p = .02$), and in the optional act condition ($\chi^2 (1) = 10, p = .002$). Using McNemar’s chi-square, we found that the preference for the just-one response did not change significantly between the obligatory act and optional act conditions ($p = .58$). If ‘some’ sentences only had U-readings, then we should expect no just-one choices on obligatory trials, and obligatory change on optional. Neither of these outcomes was found.
If ‘some’ sentences only have an E-reading, then rate of acting on optional trials should be at same ‘noise level’ as no-action trial, but this is not the case ($\chi^2 (1) = 4.2, p = 0.04$). Another prediction to consider concerns the obligatory act condition where all three girls who baked cakes ice none. If only E-readings are available, then we could assume that choices on how to make the sentence true between the two alternatives (both iced or just one) would be at random. In fact, rates of single icings are clearly greater than 50% (i.e. 72%). We are unsure what can explain this effect. One possibility is that participants somehow are encouraged to treat the indefinite ‘a cake’ as specific or some kind of singleton. In fact, if we assume all universal responses (28%) were just a result of a random selection between two options for people accessing the E-reading without the additional singleton construal, then around 16% of respondents would have to have acted based on a singleton response. (However we note that, if this were the case, then we could not tell if they access the E-reading or the U-reading for the sentence - see also the discussion of strategies in Section 4).

Another consideration to take into account for ‘some’ donkey sentences is that they may be more susceptible to a non-quantificational interpretation than other existential quantifiers (Champollion et al., 2018). For example, the subject noun phrase could be construed as introducing a discourse referent, or itself being interpreted specifically – rather than as a generalised quantifier. These choices could impact on readings for the sentence. We set aside resolving what is happening in the ‘some’ case, noting here only that the results are not straightforward to interpret.

To the extent that we have evidence that participants are able to access both U- and E-readings for both ‘every’ and ‘more than two’ sentences, we can consult the act-out results to gain some further information on the extent to which these readings are available. Consider the obligatory act condition. If you access the U-reading you have to click on ‘both cakes iced’, but if you access the E-reading it does not matter if you click on both iced or just one iced. Now, we see that there are some responses where the person has clicked on the just one iced radio button (not the both iced one). This response must be based on E-reading. So, if we assume that this choice is made at random, then we can infer that if n responses where to click on the ‘one-iced/one-not’ button, then our best guess would be that around 2n participants access only the E-reading. Our best guess then is that around 50% of participants only access E-readings for ‘more than two’, while around 36% of participants only access E-readings for ‘every’.

4. General Discussion

In summary, the act-out task results confirm that (in some but not all cases) participants respond as if both E- and U-readings of ‘every’ donkey sentences are available. Given the results of the verification tasks both in our Experiment 1 and Geurts (2002), as well as widely shared intuitions, we have evidence to support a duality of possible construals for this kind of sentence. Importantly, we have indirect evidence for our assumption that competing motivations of Caution and Economy were at play for our participants in the act out task. We can examine the other act-out results in this light. Recall that in Experiment 1 almost all participants responded ‘false’ to ‘no’ sentences, and ‘true’ to ‘some’ and ‘more than two’. This could be because these sentences only give rise to E-readings. However, in the case of ‘some’ and ‘more than two’, an
alternative explanation was that participants respond ‘true’ when two readings are available and one is true. This cannot apply to ‘no’ sentences in the verification task. An important role for the act out task was to change the motivations for response when two readings are available from a ‘Charity’ response in verification tasks to the trade off between Caution and Economy – as found in ‘every’ trials. Results for ‘some’ sentences in the act out task were equivocal but for ‘more than two’ we found patterns of response similar to the ‘every’ case and consistent with the two-construal view. In addition results of the ‘more than two’ act out task tended to disconfirm the E-reading-only view.

4.1 Finding missing readings

Thus, contrary to some suggestions in the literature on donkey sentences, we have evidence that (at least some) existential determiners are susceptible to U-readings as well as E-readings. Our investigation, which triangulates on both verification and act out tasks has turned up something akin to the ‘phantom reading’ for modified numerals, which were uncovered in Marty, Chemla and Spector (2015). That is, a reading that has not been immediately apparent to introspection in previous literature but which is shown to be the basis of participants’ responses. In a similar way, these U-readings for donkey sentences with existential determiners seem to lurk not too far below surface awareness. These results tend to undermine suggestions made in Kanazawa (1994) that intersective determiners in general should resist a universal reading (see also Champollion et al., 2018 for further discussion).

But what of negative intersective determiners? Our results for ‘no’ sentences point strongly away from a dual reading hypothesis. The main piece of evidence here is the almost unanimous judgment that ‘no’ sentences were false in scenarios that satisfy the U-reading. The fact that no participant was inclined to take a charitable view, suggests that this reading was unavailable in these items. The same resistance to judge ‘no’ sentences as true was found for visually and situationally distinct items in Geurts (2002), adding to the conclusion that the U-reading is not available. There was further support from the act-out task for an E-reading-only account, as well as an absence of evidence for the dual-reading account. Thus, our studies suggest no U-reading for ‘no’ sentences. So what of the widely shared intuition that there are circumstances under which the U-reading emerges? To date, this intuition is based on examples like in (2):

\[
\begin{align*}
\text{(2) a. No man who had a credit card failed to use it.} \\
\text{b. No person who had an umbrella would leave it at home on a day like today.}
\end{align*}
\]

As observed in Geurts (2002) those apparent exceptions to the E-reading generalisation for ‘no’ tend to involve a predicate that is in some ways implicitly negative. If this is the only kind of case where an apparent U-reading is produced for negative determiners, this is consistent with an account for one reading of donkey sentences (the E-reading for ‘every’ and ‘more than some’ sentences) as resulting from a ‘super-narrow’ existential scope with respect to the matrix predicate. How this analysis is spelled out in detail, we leave for another occasion.²

² The ‘super narrow’ account of E-readings for ‘every’ and existential determiners would have to be combined with a mechanism for deriving their U-reading which in turn only derives an E-reading for ‘no’ and other negative constructions. We believe several such mechanisms are possible but leave consideration of these for another occasion.
4.2 A key role for context?

While some accounts for the readings of donkey sentences have focused on properties of the determiner and their influence on how construals of donkey sentences are derived, other accounts have laid the burden of explanation for the variety of readings on the role of context. To some extent, this begins with early observations that U- and E-readings for singular donkey sentences seem to arise in contexts where the same readings arise for plural definite descriptions or plural donkey pronouns (Krifka, 1996; Yoon, 1996). For example, in (3)a below we can see that the plural definite has a construal which can be glossed as existential (‘some of his windows’), while (3)b has one which is universal (‘all of his windows’) and the idea is that this variation is based in some ways on context:

(3) a. Max left his garage windows open while he was away.
    b. Max left his garage windows shut while he was away.

The appeal to context in explaining this difference might go as follows: Thinking about home security issues, it would be relevant to know that Max leaves even some of his windows open while he is out, but hardly more relevant to know that he leaves all of his windows open; by contrast, knowing that he shuts some or all of his windows hardly resolves questions related to security, while the information that he shuts all of them does. Both Krifka and Yoon observe that these factors influence donkey sentence construal in apparently similar fashion:

(4) a. Usually, if a person has a garage with a widow, they leave it open while they are away.
    b. Usually, if a person has a garage with a widow, they leave it shut while they are away.

Early proposals that assimilate the interpretation of singular donkey pronouns to plurals were shown to be very problematic (Kanazawa, 2001). Nevertheless, more recent proposals avoid treating the terms themselves as plurals while being able to capture the same intuition. Specifically, Champollion et al. (2018) adapts the treatment of definite plurals found in Kriz (2015) to explain the conditions under which U- and E-readings of singular donkey sentences may arise. The leading idea is that a sentence for which there is not one specified reading poses a dilemma for the language user as to how to understand it. The proposal is that, in that case, the strategy would be to consider the sentence true if it is true on all readings and false if it is false on all readings. In ‘mixed’ or ‘non-homogeneous’ cases, no determinate truth value can be assigned. However, following Kriz, Champollion et al. (2018) propose that mixed scenarios can be assimilated to the set of true or false scenarios, depending on the contextual Question Under Discussion (QUD). To be more concrete, let us consider a proposal for an ‘every’ donkey sentence, based on Champollion et al. (2018):

(5) Every girl who baked a cake iced it.
    - True iff every girl who baked a cake iced all of the cakes she baked
    - False iff some girl who baked a cake did not ice any of the cakes she baked
    - # otherwise
A state of affairs, $w_\#$ in which every girl ices some of the cakes she bakes but not all girls ice all is one of these mixed scenarios. Let us assume that (5) addresses a QUD which partitions the context so that true scenarios ($w_T$) and false scenarios ($w_F$) lie in different cells. Then we can say that (5) can be treated as true in $w_\#$ if $w_\#$ belongs to the same cell of the partition determined by the QUD as $w_T$. For example, if we are interested in how many girls did any icing of their cakes then $w_\# \approx w_T$. Likewise, (5) is treated as false in $w_\#$ if $w_\# \approx w_F$. Based on Champollion et al. (2018), proposals for donkey sentences with ‘no’ and existential determiner, ‘more than two’ are given in (6) and (7):

(6) No girls who baked a cake iced it.
   - True iff no girl who baked a cake iced any of the cakes she baked
   - False iff at least one girl iced all of the cakes they bake
   - # otherwise

(7) More than two girls who baked a cake iced it.
   - True iff more than two girls who baked a cake iced all of the cakes she iced
   - False iff two or fewer girls iced some of the cakes they baked
   - # otherwise

Champollion et al. (2018) suggest that a default reading (in the absence of any specific context) could be one based on a maximally inquisitive context, where for all $w_i, w_j$, $w_i$ is not equivalent to $w_j$. This means that the default reading for ‘every’ and existential donkey sentences would look like a U-reading, while for ‘no’ sentences it look existential (but see footnote 3). We can assume that we move away from the default where information indicates a different kind of QUD. For example, examples sentences in (3)-(4) themselves are suggestive of different kinds of QUDs and, as such, suggest E-readings for the (a) versions and U-reading for the (b) versions.

Before we move on to consider this account in light of our experimental results, we would point out that while we can see how it works very well for plural donkey sentences, our intuitions resist a straightforward application to singular donkey sentences when it comes to the ‘no’ case. Consider that (8) below suggests a non-homogeneous interpretation. I.e. it could easily be judged true where Smith vaccinated some but not all cows by the deadline:

(8) Farmer Smith was fined because he didn't vaccinate his cows by the government deadline.

As with (3) above, we can explain this intuition as arising from a QUD about whether the explanation for a fine would be not following government rules to vaccinate all of one’s livestock. Presumably, this QUD is naturally suggested given the sentence itself and background knowledge. This same combination of sentence and background knowledge seems to readily give rise to the U-reading for the plural donkey sentence in (9) below:

(9) No farmer who owns donkeys vaccinated them before the government deadline.

However, we find a clear contrast in the availability of the U-reading between (9) and (10) below, with only difference being the number on the pronoun:
(10) No farmer who owns a donkey vaccinated it before the government deadline.

Returning to our experimental data, what can we say about our participants’ responses in light of these proposals about a role for QUD in determining readings? We can assume that participants may not be able to discern from the items any particular QUD. In that case, following Champollion et al., they would use the default QUD – what is the case? However, as for (3)-(4) and other examples above, participants may imagine more specific contexts for the stimuli. In particular, they may imagine QUDs that would yield U- or E-readings – of the kind suggested below:

- Possible QUDs for our items.
  QE: How many girls who made cakes got to do any icing?
  QU: How many girls who made cakes completed their tasks and iced them all?
  QD: What is the case?

Turning to the verification task with ‘every’, a ‘true’ response must have arisen from a participant being able to see a plausible QE. Due to charity, this could have been in addition to seeing a specific QU and/or the QD. A false response for ‘every’ must have resulted from participants only projecting a QU or potentially also QD.\(^3\) Looking at our results for ‘every’, we can estimate that in around 60% of critical trials, participants could plausibly project a QE in addition to possibly also projecting QU/QD, while on 40% of trials participants failed to discern a QE. For sentences with ‘more than two’, verification task results suggest that participants must have seen a QE on all virtually all critical trials. It is interesting that in critical trials for ‘every’ and ‘more than two’, items did not have visually different displays. This means that the only difference was the determiner. Following a strong context-based explanation of readings, we would have to assume that different determiners (‘every’ vs. ‘more than two’) carry with them different biases (prior probabilities) for different contexts. While this is not completely implausible, it is puzzling why it would be so. As such, it makes sense at this stage to consider that determiner specific strategies could explain this difference.

4.3 Verification strategies as an extra factor

Geurts (2002) observes that, when verifying a sentence with an intersective determiner (this would include both existential determiners and ‘no’), it is a generally useful strategy to seek critical evidence in a sub-model of the whole model. In the case of existential determiners, this would be positive evidence. In accounting for the strong tendency for donkey sentences with existential determiners to yield an existential response in his own experiments, Geurts suggests that, whether a participant has derived a U- or E-reading, an application of the strategy of inspecting sub-models could yield an existential response. To illustrate with our own items above, Geurts’ idea is that even if a participant has in mind a U-reading it is possible that they

\(^3\) Since test scenarios are ‘mixed’ scenarios and a QD leads to a homogeneous reading, the ‘every’ sentence would lack a truth value in such scenarios. However, no third response option is given to our verification task participants, so we could assume they favour a rejection (‘false’) response to register infelicity. Thus default QUDs would produce outcomes similar to a QU. This is what we assume here, though we are disinclined to put too much weight on this assumption.
selectively ignore un-iced cakes, so long as they can pair some/more than two cake-baking girls with iced cakes. As Champollion et al. note, their own account of donkey sentences can be combined with this account of verification strategies. If we follow this suggestion, it would allow us to resolve the puzzle of the divergence in existential responses between ‘every’ and existential determiners for the verification task. It could be that on around 40% of ‘more than two’ trials, participants do not project a QE, leading to only QU/QD contexts and U-readings but in these cases they are strongly biased to adopt the sub-model strategy, yielding what looks like an existential response. While this is not impossible, we should note that our act-out data would pose problems for this position unless we were to assume that the sub-model strategy is only adopted on verifications tasks, not the act-out (see Section 3.5).

4.4 Back to ‘no’

If we assume that it is a plausible approach for ‘more than two’ to adopt a multi-factor account of the readings of donkey sentences, with projected context (QU/D) and determiner-specific strategy playing a role, we should also consider what this account implies for our ‘no’ data. Test items in the verification task for ‘no’ were minimally different to those for ‘every’/‘more than two’ – a single cake which is un-iced in the latter case is iced in the former (see Fig. 1 above). On the face of it, results for ‘no’ suggest that QU is not projected at all, with QE (and perhaps also QD) the prevailing contexts. While we cannot rule this out, it would be surprising if no QU is projected for ‘no’ without also not being projected for other determiners. Since we did not provide a third ‘don’t know’ response option for our trials, we cannot rule out that all rejection responses in the ‘every’ trials were based on QD rather than QU context (see footnote 3). We note that in Geurts (2002), where participants were given a third response option, very few chose that and this would be consistent with ‘false’ responders accessing QU contexts rather than QD. So we have reason to doubt that so-called ‘default’ contexts would dominate in these kinds of sentence-picture verification tasks.

So, let us now suppose a multi-factor account, assuming that QU is sometimes adopted for ‘no’, but that participants are strongly biased to adopt a sub-model strategy. For the negative quantifiers, this is to seek disconfirming information in sub-models, selectively seeking the iced cakes to falsify the sentence. Again, we do not find this assumption unproblematic since we would have to suppose that the sub-model strategy for positive quantifiers has one aim (to selectively attend to confirming information), while the strategy for negative quantifiers has the opposite aim. The latter aim is at odds with the assumed principle of Charity.

5. Conclusion

Previous experimental research on the U/E ambiguity of donkey sentences has been unable to detect both readings across different classes of determiner. This paper adds to the small body of controlled experimental data on readings of donkey sentences by providing clear evidence in support of analyses of donkey sentences with existential determiners (‘more than two’) as having both U- and E-readings. In addition, our studies throw up evidence against accounts that predict only E-readings for these sentences. By using both verification and act-out
paradigms, we have been able to tease out ‘phantom readings’ of existential donkey sentences, lying not far from the surface of theorists’ introspective access. By contrast, we were unable to unearth a second U-reading for ‘no’ sentences, replicating results from Geurts (2002); plus we provide some evidence against the idea that ‘no’ sentences have two readings.

Because there are many potential factors that may contribute to donkey sentence readings, relating to context and determiner specific strategies, further work is required to test these in more detail. However, we remain skeptical that negative determiners like ‘no’ can give rise to a U-reading.

References

**Same as the parameter of an equation construction**

Yenan SUN — *The University of Chicago*

**Abstract.** Rett (2013) proposes that the difference between scalar equatives (*Mary is as tall as Sue is*) and similatives (*Mary danced as Sue did*) in terms of whether a parameter marker (i.e. the underlined *as*) is needed, can be attributed to their difference in whether lexicalized arguments are equated (degrees vs. manners). This paper shows that the *same*-sentence, which is a kind of equation construction, poses a challenge to Rett (2013) at first sight and to maintain her proposal, I argue that a null parameter marker must co-occur with the parameter *same*. Moreover, the existence of such a null parameter marker is not simply postulated to fit *same* into Rett (2013) but rather reveals something deep about this word, as it can straightforwardly account for its extraordinary scoping pattern (Dowty, 1985; Barker, 2007; Brasoveanu, 2011).

**Keywords:** equation construction, same, parameter, parameter marker, internal reading.

1. **Introduction**

Haspelmath and Buchholz (1998) (H&B henceforth) categorize a class of sentences which equate various types of semantic object such as individuals, degrees, manners, and times ((1)-(2)) as *equation constructions*.

1. (a) Mary met *the same boy as* Sue did. (Equating individuals)
   (b) Mary is *as tall as* Sue is.

2. (a) Mary danced *as Sue did*. (Equating manners)
   (b) Mary danced *as Sue sang*. (Equating times)

Those constructions (partially) share the morphological make-up and henceforth I follow H&B in referring to the various parts of an equative with the terminology in (3).

(3) Mary *comparee* is *as PM tall parameter as SM [Sue is] (clausal) standard* (PM: parameter marker; SM: standard marker)

H&B observe two cross-linguistic tendencies for equation constructions: (i) Languages tend to use the same morpheme to mark the standard in *equation* constructions. (ii) Languages generally can form equatives with a parameter marker (PM, underlined in (1)), namely a word that explicitly introduces an equation relation, but cannot form similatives with a PM, as evidenced in the ungrammaticality of (4).

4. (a) *Mary as danced as Sue did.*
   (b) *Mary as danced as Sue sang.*

Rett (2013) for the first time provides a formal theory that successfully captures the above two tendencies in English (and potentially cross-linguistically). She proposes a uniform analysis

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of the standard marker *as in both scalar equatives and similatives as ‘a relativizer with an unspecified domain’ to capture the tendency (i). For tendency (ii), which is the main focus of this paper, Rett attributes such a contrast between equatives and similatives to the difference of whether lexicalized arguments are equated in those constructions. If the construction equates lexicalized arguments like individuals and degrees, the presence of a PM is required in English. For instance (1b) semantically equates degrees, and degrees are lexicalized arguments of the parameter (provided by the adjective *tall), the presence of a PM is thus required. If the construction equates non-lexicalized arguments like manners and times, the presence of a PM is prohibited as in (4). The fact that a similative like (5) can not have an interpretation of equating degrees thus provides a novel argument against treating degrees as lexicalized arguments of verbs (contra Piñón, 2008; Bochnak, 2013).

(5) *The cakes were (as) cooled as the cookies were.
   Int: ‘The cakes and the cookies were cooled to the same degree’

Among those equation constructions, the same-construction (SAME) is only briefly discussed in Rett (2013). The first goal of this paper is to propose a concrete analysis of SAME that fits into both H&B’s generalizations and Rett’s proposal. Whereas SAME (repeated as (6)) is taken to be one kind of equation constructions, as indicated by the existence of the standard marker *as and the equation semantics (i.e. the equation of individuals)\(^2\), how each part of the sentence in (6) is mapped to the make up in (3) is not a trivial question.

(6) Mary met the same boy as Sue did.

One immediate puzzle is that, if we follow Rett (2013) in assuming a PM (i.e. same) exists in SAME because the sentence (6) equates lexicalized arguments, it is unclear which part in (6) provides the parameter that is parallel to the gradable adjective in a scalar equative. Though Rett does not make it explicit, a very natural thought is that the common noun boy in (6) provides the parameter since it denotes a one-place predicate which takes individuals as its argument. However such a hypothesis, as we will turn to in the next section, is rejected mainly because common nouns differ from gradable adjectives in a fundamental way, leading to their disqualification as parameters.

The plan of this paper is as follows. Section 2 discusses why taking the nominal modified by same as the parameter is problematic. Section 3 presents a new analysis of same, which maintains the core of Rett’s proposal of scalar equatives and crucially treats same as the parameter instead of the PM. The new analysis further assumes a null PM, which is semantically an individual quantifier. Section 4 argues that the existence of such a null equation head is not a pure stipulation. In fact, it further enables a uniform and compositional analysis of the external and internal readings of same. Section 5 concludes.

2. The problem of taking nouns as the parameter

This section shows why treating same as the PM of the equation construction fails to capture its parallel with scalar equatives under Rett’s proposal. Though SAME is not given an explicit analysis in Rett (2013), I would like to go through the original discussion in her paper as our starting point here. Rett argues that the two equation constructions in (7) both have (obligatory)

\(^2\)A more detailed overview of the motivations to analyze SAME and other equation constructions uniformly can be found in Alrenga (2007, 2010) and Oxford (2010).
PMs because lexicalized arguments are equated. (7a) equates individuals, which are the object arguments of each clause, thus it obligatorily requires the individual quantifier \textit{same} (Alrenga, 2007; Barker, 2007; Brasoveanu, 2008). (7b) equates degrees, which are lexicalized arguments of gradable adjectives, thus it requires the PM \textit{asPM}, which is semantically a degree quantifier.

(7) a. Mary met the same boy as_{SM} Sue. \hspace{1cm} same-construction
b. Mary is as_{PM} tall as_{SM} Sue. \hspace{1cm} equative

Note that Rett does not specify the individuals being equated in (7a) are lexicalized arguments of which predicate – since PM immediately precedes the parameter to ‘mark’ it in the scalar equatives, a natural move is to take the noun modified by \textit{same}, namely \textit{boy}, as the parameter in (7a). However, from a theoretical perspective, common nouns seem to lack the core property of a \textit{parameter}. A gradable adjective is called a parameter because it denotes a property that needs to be fixed relative to the scale, which is formed by a linearly ordered set of degrees (Cresswell, 1976; Stechow, 1984; Bierwisch, 1989; Kennedy, 1999). The semantics of gradable adjectives encodes a measure function that maps an individual to some abstract measurements, namely (ordered) degrees, taking \textit{tall} as an example in (8).

(8) \[ [\text{tall}] = \lambda d \lambda x. \text{HEIGHT}(x) \geq d \]

We will discuss a more general version of measure function (based on Alrenga, 2007) in Section 3 that does not necessarily involve degrees but rather other possible forms of measurement. For now it is sufficient to notice that the property denoted by a common noun does not need to be fixed by any measurement, at least not in an obvious way. Those predicates differ from the gradable adjectives in a fundamental way such that it is not clear why a property of ‘being a book’ should be fixed by any measurements.

Relatedly, the fact that the noun \textit{boy} is a one-place predicate but not a two-place one like gradable adjectives causes a problem in compositionality. In Rett (2013) the PM scopes out and its trace is interpreted as a variable of type $\tau$ ($\tau$ is the type of the objects being equated). In a scalar equative, the degree quantifier \textit{asPM} scopes out and its trace is interpreted as a degree variable (following a standard treatment of comparatives), which saturates the gradable adjective and results in a property (type \langle e,t \rangle), as in (9). However, if the parameter is a one-place predicate like \textit{boy} as in (10), it can no longer compose with the rest of the clause after taking the individual variable that results from the trace of the individual quantifier \textit{same}.

(9) $\text{asPM} \ldots [\text{OP}_d \text{Mary met a } d\text{-tall boy}]$ \hspace{1cm} 3
(10) $\text{samePM} \ldots [\text{OP}_x \text{Mary met a } x\text{-boy}]$

In short, we fail to identify a suitable candidate for the parameter when \textit{same} is assumed as the PM (parameter marker).

3. The proposal: \textit{same} as the parameter

The new proposal inherits the basic idea from Alrenga (2007) (among others) that SAME and scalar equatives form a parallel. I argue that the proposed correlation between the existence of PM and the equation of lexicalized arguments in Rett (2013) can be successfully extended to

\footnote{A detailed derivation of equatives will be presented in Section 3.1 and the focus here is that the degree quantifier takes scope.}
SAME if we assume same per se provides the parameter, and the PM is a null equation head (‘θEQTV’) that obligatorily co-occurs with same as in (11). Syntactically this null head selects an adjectival phrase and projects an equation phrase (EqP), which is a more generalized version of comparison phrase than DegP such that semantically other kinds of abstract measurement besides degrees can be involved in the relevant comparison. The structural parallel between SAME and scalar equatives is shown in (11) and (12).

(11) SAME

```
  EqP
 /  \
  Eq AP
 /  \
θEQTV same
```

(12) Scalar equatives

```
  EqP
 /  \
  Eq AP
 /  \
asPM tall
```

Semantically I propose that the PM ‘θEQTV’ is an individual quantifier and same is qualified as a parameter just like gradable adjectives crucially in that it also denotes a property which must be fixed by some measurement, namely individuals, as in (13). More specifically, the ‘measure’ function encoded in same is SELF, which maps an individual to itself. Adopting the semantics of the degree quantifier asPM in Rett (2013) and the standard treatment of gradable adjectives, the parallel between SAME and scalar equatives can be seen in (13) and (14).

(13) a. \[θEQTV\] = \(\lambda D_{et}\lambda D'_{et}.\text{MAX}(D') = \text{MAX}(D)\)
b. \[[\text{same}]\] = \(\lambda y\lambda x.\text{SELF}(x) = y\)

SELF is a function that maps an individual to itself.

(14) a. \[asPM\] = \(\lambda D_d\lambda D'_{dt}.\text{MAX}(D') \geq \text{MAX}(D)\) (Rett, 2013: 1107(15))
b. \[[\text{tall}]\] = \(\lambda d\lambda x.\text{HEIGHT}(x) \geq d\)

HEIGHT is a function that maps an individual to the degree of its height.

Notice that the semantic entry of same in my proposal is equivalent to an identity relation, which has been widely adopted in the literature on same (Barker, 2007; Brasoveanu, 2011; Hardt and Mikkelsen, 2015; Charnavel, 2015; Hanink, 2017). The rest of the paper will use the derived result in (15b) for convenience, but we should keep in mind that its underived form in (13b) is meaningful in introducing a ‘measure’ function for the parameter same.

(15) a. SELF: \(\lambda x.x\)
b. \[[\text{same}]\] = \(\lambda y\lambda x.\text{SELF}(x) = y\)

\[= \lambda y\lambda x.(x = y)\]

The new proposal is able to maintain Rett’s proposal: same is a 2-place predicate that plays the role of parameters, and the arguments which are equated, namely individuals, are indeed lexicalized arguments of same. Since lexicalized arguments of the parameter are equated in SAME, the PM is required, which is captured by the head-complement relation between θEQTV and same.

The plan of this section is as follows: Section 3.1 goes through Rett’s theory of scalar equatives, which is helpful to our presentation later. Section 3.2 elaborates on the new proposal and illustrates the step-by-step derivation of same-constructions. We will focus on the attributive use of
gradable adjectives and *same* with clausal standards but in principle with certain assumptions it can extend to other uses.\(^4\)

3.1. The theory of scalar equatives

I illustrate the syntactic assumptions and Rett’s theory of scalar equatives with (16), which is featured by the attributive use of the gradable adjective and the clausal standard.

\[
(16) \quad \text{Mary met as}_{PM} \text{tall a boy as}_{SM} [_{CP} \text{Sue did}].
\]

For the syntax of (16), I assume that the Eq head (or degree head) forms a constituent with AP (Abney, 1987; Kennedy, 1999), as in (17) and the standard clause (asP) is late-merged with the Eq head after the Eq head moves to its scope position (Bhatt and Pancheva, 2004), as in (20) which we will turn to shortly. The AP should be further fronted to derive its precedence to the indefinite article but I will constantly omit such movement (see Matushansky, 2002) in the derivation in this paper. The clausal standard (asP) is an elided clause with obligatory Comparative Deletion (Bresnan, 1973), as in (18).

\[
(17)
\]

\[
(18)
\]

According to Rett, in the standard clause, the degree argument of the gradable adjective gets valued by a free variable (i.e. \(\delta\)) and the standard marker \(\text{as}_{SM}\) then binds that free variable as a relativizer with an unspecified domain, which plays the same semantic role as a *wh*-operator such that it \(\lambda\)-abstracts over \(\delta\), resulting a set of objects that are of the same type as that free variable. The operation \([d/\delta]\) in (19) replaces all occurrences of \(\delta\) in a clause \(S^\delta\) with the variable \(d\), and returns a set of degrees.

\[
(19) \quad []_{as_{SM}}S^\delta = \lambda d.[]_{S^\delta}[d/\delta]
\]

Since the PM \(\text{as}_{PM}\) is a degree quantifier which takes two sets of degrees as its arguments, it cannot be interpreted in situ and must scope out, as in (20). I follow Bhatt and Pancheva (2004)

\(^4\)For instance, this paper does not discuss the so-called ‘predicative’ use of *same*, in which no overt nominal follows *same*, as in (i). The reason is not that the semantics we assigned to *same* cannot extend to it but rather the syntax of such sentences is still controversial (Alrenga, 2007).

(i) Mary is the same as Sue.

Moreover, I focus only on the identity reading of *same* and a potential similarity reading (Alrenga, 2007) is taken to be a case of pragmatic halos (Lasersohn, 1999) instead of a genuine distinct reading.
in assuming the moved PM is right-adjoined to the matrix clause and takes the standard clause as its argument via late merge. The trace of the PM is interpreted as a degree variable and a null wh-operator λ-abstracts over it to create a set of degrees.

\[(20)\]

The gradable adjectives such as tall are analyzed as relations between individuals and degrees, as repeated in (21). To shorten the formula, I deviate from the standard formal representations and use ‘tall(x,d)’ as an abbreviation for ‘HEIGHT(x) ≥ d’ and ‘P(x,y)’ as an abbreviation for ‘P(y)(x)’.

\[(21)\]

Now we are ready to derive the semantics for the entire sentence (16). The asP and CP in (20) both denote a set of degrees, as in (22). The semantics of the parameter marker asPM is a degree quantifier in (23), which involves a weak linear ordering ‘≥’ between the maximal members of two sets of degrees (Horn, 1972; Seuren, 1973; Schwarzchild and Wilkinson, 2002).

\[(22)\]

\[(23)\]

Under Rett’s analysis, (24) asserts that the maximal member of the first degree set (which characterizes the height of a boy whom Mary met) ranks at least as high as the maximal member of the second degree set (which characterizes the height of a boy whom Sue met) on the scale. This truth condition captures the intuition that (16) is true if only if the height of the boy that Mary met is no less than the height of the boy that Sue met.

I will maintain most parts of the theory in Rett (2013) about the LF and the standard marker in equatives in my proposal for SAME.
3.2. Theory of SAME

This subsection illustrates how the proposal for SAME in (11) and (13), repeated in (25), derives the correct truth conditions for SAME with the example in (26).

(25) Proposal:

\[
\begin{align*}
\text{EqP} & \quad \text{AP} \\
\Phi_{EQTV} \quad \text{same} & \quad \lambda y \lambda x. x = y \\
\lambda D, \lambda D', \text{MAX}(D') = \text{MAX}(D) & \\
\end{align*}
\]

(26) Mary met the same boy as Sue did.

The LF and semantics of (26) in (27) are familiar since they are parallel to the scalar equatives discussed in Section 3.2. The null PM scopes out and its trace is interpreted as an individual variable. In the matrix clause CP₁, a null \(\lambda\)-operator \(\lambda\)-abstracts over the variable, which creates a set of individuals.

(27)

\[
\begin{align*}
\text{CP₁} & \quad \text{EqP} \\
\lambda u. \text{met}(m, t[z[\text{boy}(z) \land z = u]]) & \quad \text{asP} \\
\text{OP}_u & \quad \text{as Sue did} \\
\text{Mary} & \quad \text{the} \\
\text{met} & \quad \lambda x. \text{boy}(x) \land x = u \\
\text{NP} & \quad \text{NP} \\
\text{EqP} & \quad \text{NP} \\
\lambda x. x = u & \quad \lambda x. \text{boy}(x) \\
\text{AP} & \quad \text{same} \\
\end{align*}
\]

I assume the standard in (26) is an elided clause ‘Sue met the \(\delta\)-same boy’, which contains a free variable in the position of PM. The relativizer \(\alpha_{SM}\) takes a clause with a free variable \(\delta\) (type \(e\)) and \(\lambda\)-abstracts over the variable as in (28), which results in another set of individuals.
Within the DP objects of the matrix clause and the standard clause, a variable saturates the first argument of \([same]([S^\delta])\), which returns a property of being the individual denoted by the free variable under the model. Since there can always be one single individual that is equivalent to an individual, namely that individual itself, this is a property with one single individual in its extension. This is a desirable result since the uniqueness presupposition of the definite article is satisfied in (26). In fact, based on the Maximize Presupposition principle (Heim, 1991), the definite article for \(same\) is enforced in English, as the nominal which has a single individual in its extension like sun must co-occur with the. Such a principle accounts for the fact that \(same\) is not only compatible with the, but must always co-occur with it as in (29).

(29)  
*Mary met \{a, some, one\} same girl as Sue (did).

The final derivation of the semantics of (26) is shown in (30)-(31):

(30)  
a.  \[\llbracket CP_1\rrbracket = \lambda u.\text{met}(m, z[\text{boy}(z) \land z = u])\]

b.  \[\llbracket asP\rrbracket = \lambda i.\text{met}(s, z[\text{boy}(z) \land z = i])\]

(31)  
\[\llbracket (26)\rrbracket = \llbracket asPM\rrbracket (\llbracket asP\rrbracket) (\llbracket CP_1\rrbracket) = \text{MAX}(\lambda u.\text{met}(m, z[\text{boy}(z) \land z = u]), \lambda i.\text{met}(s, z[\text{boy}(z) \land z = i]))\]

(31) can be paraphrased as follows: the maximal member of the set of the individuals which are the individuals that Mary met and are boys bears the equivalence/identity relation ‘=’ to the maximal member of the set of individuals which are the individuals that Sue met and are boys. Since in this sentence they both met one boy, the two relevant sets which are arguments of the quantifier \(\theta_{EQTV}\) is a singleton set, and the MAX operator would just pick out the single boy in either set. The ‘=’ relation between the two is only true if the two are one and the same individual. My proposal thus derives the right semantics for (26).

To sum up, this section proposed a concrete analysis of SAME, which holds that \(same\) is the parameter (encoding a measure function \(\text{SELF}\)) and a null PM \(\theta_{EQTV}\) obligatorily co-occurs with it. The proposed analysis maintains Rett’s proposal of equation constructions and derives the desired semantics for SAME.
4. Unifying the internal and external same

This section presents one more argument for the current proposal, especially for the existence of a null PM in SAME. One old puzzle about same in the literature is that whether its external use and internal use can be unified (Barker, 2007; Brasoveanu, 2011; Brasoveanu and Dotlačil, 2012; Charnavel, 2015). All the sentences that I have analyzed so far involve the external use, since the standard is introduced ‘externally’ by an overt complement, as in (32).

(32) Mary met the same boy [as Sue did].

Besides the external use, it has been argued that same can also be used ‘internally’ as in (33), which has a reading ‘each of the girls met the same boy as the others’ (Dowty, 1985; Carlson, 1987; Barker, 2007). Such a sentence involves multi-comparisons between every two girls in terms of the boys they met without introducing any explicit standard.

(33) The girls met the same boy.

What is special about the internal reading in (33) is that the comparison is ‘distributed’ over every two girls even though there is no overt distributor in the sentence. This is striking since other predicates that denote a symmetric relation such as identical and similar do not have such a pattern:

(34) Internal reading intended:
   a. #The girls met {an, the} identical boy.
   b. #The girls met {a, the} similar boy.

The rest of the section demonstrates that how the null PM in the current proposal can conveniently derive such a property of same, making possible a uniform analysis of different uses of same. Therefore, positing a null PM is not only meaningful in maintaining Rett’s proposal but also sheds light on the general properties of same.

To derive the internal reading of same such as (33), I argue that a phrasal version of the PM $\theta_{EQTV}$ is involved. Following the literature in comparatives (Kennedy, 2007; Bhatt and Takahashi, 2011), comparative heads are often treated as either a 2-place degree quantifier (clausal version) or a 3-place predicate taking two individual arguments and a predicate of individuals and degrees (phrasal version), as in (35).

(35) a. $[-er]$ (clausal) $= \lambda D_{el} \lambda D'_{el}.\text{MAX}(D') > \text{MAX}(D)$
   b. $[-er]$ (phrasal) $= \lambda P_{(d,et)} \lambda y \lambda x_e.\text{MAX}(\lambda d.P(x,d)) > \text{MAX}(\lambda d'.P(y,d'))$

Bhatt and Takahashi (2011) argue that both options are available in English. For this reason I assume that the phrasal version of $\theta_{EQTV}$ is also available in grammar, as in (37b).

(36) The girls met the same boy.

(37) a. $\theta_{EQTV}$ (clausal) $= \lambda D_{el} \lambda D'_{el}.\text{MAX}(D') = \text{MAX}(D)$
   b. $\theta_{EQTV}$ (phrasal) $= \lambda R_{(e,et)} \lambda y \lambda x_e.\text{MAX}(\lambda z.R(x,z)) = \text{MAX}(\lambda z'.R(y,z'))$

Due to the limit of space, I will not discuss the internal reading of the same-sentences with overt distributors such as (i) since it is not a property specific to same. Other symmetric relational terms such identical and similar can also have such a reading as in (ii):

(i) Every girl met the same boy.
(ii) Every girl met a(n) {identical, similar} boy.
With this phrasal version of the PM, we are ready to derive the internal reading. First, the parasitic scope (Barker, 2007) is applied such that the plural subject the girls is scoped out and then the phrasal \( \theta_{\text{EQT}} \) scopes out and intervenes between the plural subject and its scope, as in (38). This step makes the scope of \( \theta_{\text{EQT}} \) ‘parasitic’ on the scope of the girls. The traces left by them are interpreted as individual variables in situ.

(38)

The relation created by QR ([\( TP_2 \)]) is a familiar one: a relation between an individual \( t_1 \) and an individual \( t_2 \) such that the boy which \( t_1 \) met is exactly \( t_2 \). This relation saturates the first argument of equation head and yields a new relation ([\( TP_3 \)]) between individuals \( x \) and \( y \) such that the boy whom \( x \) met is exactly the boy whom \( y \) met.

The potential type mismatch between [\( TP_3 \)] and [\( DP_2 \)] triggers the application of \( \text{Hmg} \) (homogeneity, see similar operations in Chatain, 2019; Beck, 2000, 2001; Schwarzschild, 1996). This operation freely transfers any symmetric relation \( R \) into a property of a plural individual \( X \) such that \( R \) holds between all the atomic parts of \( X \), as in (39a). This operation is not uncommon in the grammar, which for instance is sometimes overtly realized as the prefix a- in English (39b):

(39) a. Operation \( \text{Hmg} \): For any symmetric relation \( R \), \([R^{\text{Hmg}}] = \lambda \forall x, y \in X [R(x, y)]\).

b. ‘Darci is like Betty’ → ‘The girls are alike’.

Since [\( TP_3 \)] is a symmetric relation, applying \( \text{Hmg} \) as in (40) distributes this symmetric relation between all the atomic parts of the plural individual denoted by the girls (its denotation is informally represented as \( G \)), deriving the internal reading as in (41). (41) can be roughly read

\(^6\)The symmetric relation is defined as follows in this paper: If for any \( x \) and \( y \), \( R(y)(x) \leftrightarrow R(x)(y) \), then \( R \) is a symmetric relation.
as ‘for every pair of girls \(x\) and \(y\): the boy whom \(x\) met is the boy whom \(y\) met’.

\[
\begin{align*}
\text{TP}_3^{Hmg} &= \lambda X. \forall x, y \leq X \left[ \text{MAX} (\lambda z. \text{met}(x, tu[\text{boy}(u) \land u = z])) = \text{MAX} (\lambda z'. \text{met}(y, tu[\text{boy}(u) \land u = z'])) \right]
\end{align*}
\]

\[
\begin{align*}
\text{TP}_4 &= \forall x, y \leq G \left[ \text{MAX} (\lambda z. \text{met}(x, tu[\text{boy}(u) \land u = z])) = \text{MAX} (\lambda z'. \text{met}(y, tu[\text{boy}(u) \land u = z'])) \right]
\end{align*}
\]

The key thing here is that the null PM, just like the equation head in scalar equatives, can QR and abstract over the relevant variable. Via parasitic scope, a 2-place relation is available and is applied as the first argument of the PM, which distributes this relation twice in the formula. This step is crucial since that is why the VP ‘met the same boy’, which involves a singular event based on its morphology, is distributed among all the atomic subpart of a plural individual, and the comparison is further made between every two atomic subparts of a plural individual via \(Hmg\).

In sum, the current proposal provides a uniform way to derive the external and internal readings of \textit{same} compositionally. Whereas there are other uniform analyses in the literature (Brasoveanu, 2011; Charnavel, 2015; Hardt and Mikkelsen, 2015), none of them relates such a property of \textit{same} to Rett (2013) discussion of equation constructions. Thus my proposal is the first to bring together the strand of work on the internal/external readings of \textit{same} on the one hand, and another strand of work on the general equation constructions.

5. Concluding remarks

This paper makes two contributions. First, I propose an explicit analysis of the \textit{same}-sentence that can fit into Rett (2013) proposal of equation constructions in general. In particular, I argue that \textit{same} itself provides the parameter (encoding a measure function) and since it equates individuals, it requires a parameter marker, which is realized as a covert equation head that syntactically selects \textit{same}. Second, I demonstrate that the existence of a null PM in a \textit{same}-sentence can be further supported by the extraordinary scoping pattern of \textit{same}, namely it can license an internal reading in a sentence without overt distributors.

References


Same as the parameter of an equation construction


Informational Object Nouns and the mass/count distinction\textsuperscript{1, 2}
Peter R. SUTTON — Heinrich Heine University, Düsseldorf
Hana FILIP — Heinrich Heine University, Düsseldorf

Abstract. Most theories of the count/mass distinction analyse concrete nouns (denoting physical entities or stuff), and so, implicitly or explicitly, set abstract nouns to one side. We build on a growing number of recent works that address this gap with our analysis of a class of abstract nouns, Informational Object Nouns (IONs), such as information, evidence, belief, and statement. We argue that by incorporating recent work done by Schmitt (2013, 2017) on the development of a domain general mereological sum operation, we can modify theories of the mass/count distinction for concrete nouns and extend their coverage to the set of IONs. As we also argue, an important factor in extending such theories is that they are grounded in the notion that count nouns are interpreted under individuation schemas, relative to a context (Sutton and Filip 2016b; Filip and Sutton 2017, amongst others).

Keywords: mass/count distinction, abstract nouns, countability, individuation.

1. Introduction

Most semantic theories of the mass/count distinction are developed for concrete nouns that denote physical entities (\\textit{cat, chair}), or stuff (\\textit{sand, air}), as opposed to abstract nouns such as love, experience, information, statement. Although there are some notable exceptions (Grimm 2014; Nicholas 2010; Tovena 2001; Zamparelli 2018, amongst others), most work on the semantics of countability set abstract nouns to one side, not least since there are enough challenges with concrete nouns. However, some have even raised doubts whether extensionally defined theories for concrete nouns can be meaningfully applied to abstract nouns (Barner, 2019). In contrast to this sentiment, theories of the mass/count distinction developed for concrete nouns provide us with useful conceptual tools and formal properties needed to get a handle on characterising countability in more abstract domains (such as the domains of propositions and eventualities). In particular, we focus on abstract nouns such as evidence, information, belief, statement, and fact that we dub here Informational Object Nouns (IONs).

In section 2, we present a means of delimiting the class of IONs based on two grammatical tests: felicitous occurrence with propositional complements and truth/falsity predications. We then argue that the class of IONs shares a number of properties with a well-studied class of concrete nouns, Collective Artefact Nouns (CANs), that includes nouns such as furniture, cutlery, and jewellery. In particular, we highlight that both classes display a large amount of variation in their count/mass lexicalization patterns. When mass, both are individuated with the same

\textsuperscript{1}We would like to thank audiences at all of the following conferences and workshops for their helpful comments and feedback: Sinn und Bedeutung 24 in Osnabrück, TbilLLC 2019 in Batumi, Georgia, SinFonIJA 2019 in Brno in the Czech Republic, and to the semantics group at the University of Vienna. In particular, our thanks go to Scott Grimm, Nina Haslinger, and Viola Schmitt for some very helpful discussions. This research was funded by the DFG project CRC 991: The Structure of Representations in Language, Cognition, and Science, project C09 A frame-based account of countability.

\textsuperscript{2}This paper is a forerunner to Sutton and Filip (2019), a paper already published in the proceedings of the Amsterdam Colloquium in 2019. This paper sets out the groundwork for our analysis of Informational Object Nouns in more detail than in Sutton and Filip (2019), however, in Sutton and Filip (2019) we address more complex data, specifically the impact of pluralities of Agents and Experiencers on the interpretations of IONs.

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classifiers (item and piece), and resist mass-to-count coercion; and similarly to CANs, across different contexts, IONs overdetermine what counts as one insofar as what counts as, say ‘one belief’ in one context can count as ‘two beliefs’ in another. Finally, we identify three classes of IONs based on whether they denote sets of eventualities and on whether these eventualities are states or events.

In section 3, we show that by incorporating recent work done by Schmitt (2013, 2017) on the development of a domain general mereological sum operation, we can modify theories of the mass/count distinction that can explain the distributional patterns of CANs such that their coverage is extended to IONs. The theory for concrete nouns that we modify explains the distributional properties of CANs (that, we will argue, IONs also share) on the basis of the following two claims: (1) An extensional property underpins the distinction between count and mass nouns; (2) The lexical entries of count nouns include a context-indexed individuation schema that ensures that a quantized set is available for grammatical counting operations (see Sutton and Filip 2016a, b; Filip and Sutton 2017, amongst others). The account we propose demonstrates how extensional theories of the mass/count distinction can be extended to cover at least some classes of abstract nouns. It also explains a number of subtle distinctions within the class of IONs, for example whether they can be individuated in terms of propositions or in terms of both propositions and eventualities.

We provide a unified analysis of counting constructions for CANs and IONs in the appendix to this paper.

2. The class of Informational Object Nouns

2.1. Delimiting the class of Informational Object Nouns

We propose that the class of IONs consists of all and only those nouns that pass both of the tests (T1) and (T2) below. So N is an ION if and only if:

(T1) N that is true/false is felicitous (truth-evaluability);

(T2) N that p is felicitous (propositional complementisers)

For example, belief and statement take propositional complements: Alex’s belief/state that it’s raining, and admit of truth/falsity predications: Alex’s belief/state was true/false.

Further examples of (T1) are given in (1)-(3) for evidence, information and knowledge, and for (T2) in (4)-(6). (UKWaC = UK Web Annotated Corpus; BNC = British National Corpus.)

(1) a. The war on Iraq was the first one in which Britain has engaged on the basis of intelligence evidence alone, and that evidence has been shown to be false or exaggerated. [UKWaC]
   b. The Appellant’s written evidence which she swore was accurate and true clearly suggests that she was present at the time of Dr.Walsh’s consultation with Mrs. IM. [UKWaC]

(2) a. he successfully fed Edgar Hoover at the FBI a mixture of tantalising bits of fact and rubbish, including false information about Russia’s space-rocket programme [BNC]
b. The Candidate agrees to: Provide Information which is in all respects true and accurate... [UKWaC]

(3) a. Why bother with research? Anecdotal and expert knowledge and experience are often false when tested scientifically. [UKWaC]
   b. Thus, knowledge is always true, whereas belief admits of both truth and falsehood. [UKWaC]

(4) a. Others, however, point to some evidence that it is encouraging people to become more and more introverted... [UKWaC]
   b. there is strong evidence that many women suffer as a consequence of men’s poor health. [UKWaC]

(5) a. On [sic.] day we received information that the President would visit the Seventh Street Hospital... [UKWaC]
   b. What happens is the seismologist dealing with an earthquake gives out information that the maximum intensity of an earthquake was, say, 9. [UKWaC]

(6) a. This approach is based on the knowledge that people react to drugs differently, partly because of underlying genetic variation. [UKWaC]
   b. What I took away from the meeting was the knowledge that our union does an excellent job for us with the Clubs and Leagues we have in Britain. [UKWaC]

In contrast, nouns like feeling pass the complementiser test (T2): the feeling that I have forgotten something. However, they fail test (T1): that feeling was true is odd, if true is intended in its truth-value sense, and not in the genuine, real sense. Although concrete Ns like book, article are attested in collocations such as this article is true (understood as meaning that its content is true at a given world/time), they fail test (T2).

Based on (T1) and (T2), examples of IONs are given below:

   allegation, announcement, assumption, belief, conclusion, declaration, fact, information, intelligence, evidence, idea, judgement, knowledge, report, thought, statement, proposition, truth, utterance

2.2. Properties of Informational Object Nouns and parallels with Collective Artefact Nouns

A number of interesting parallels can be observed between the class of IONs and a class of concrete nouns that have been much studied in the literature. When mass these concrete nouns have been called object mass nouns (Barner and Snedeker, 2005; Rothstein, 2010), fake mass nouns (Chierchia, 2010), and neat mass nouns (Landman, 2011) and, in English, include nouns such as cutlery, crockery, equipment, footwear, furniture, jewellery, and kitchenware. However, as stressed by Sutton and Filip (2016a, 2016b, amongst others), there are many count counterparts to these nouns cross-linguistically. Sutton and Filip dub this wider class of nouns (both count and mass), Collective Artefact Nouns. This brings us onto our first parallel with IONs.

IONs and CANs both exhibit large amounts of cross- and intralinguistic variation in their mass/count lexicalization patterns. As indicated by Table 1, when we look crosslinguis-
**Table 1: Examples of cross- and intralinguistic count/mass variation for Collective Artefact Nouns and Informational Object Nouns**

<table>
<thead>
<tr>
<th>Mass (NOMINATIVE.PL)</th>
<th>Count (NOMINATIVE.PL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>furniture</strong></td>
<td>furniture huonekalu(t) (Finnish)</td>
</tr>
<tr>
<td></td>
<td>meubilair (Dutch)</td>
</tr>
<tr>
<td></td>
<td>meubel(s) (Dutch)</td>
</tr>
<tr>
<td><strong>jewellery</strong></td>
<td>jewellery taxilit(im) (Hebrew)</td>
</tr>
<tr>
<td></td>
<td>Schmuck (German)</td>
</tr>
<tr>
<td></td>
<td>koru(t) (Finnish)</td>
</tr>
<tr>
<td><strong>footwear</strong></td>
<td>footwear jalkine(et) (Finnish)</td>
</tr>
<tr>
<td></td>
<td>Schuhwerk (German)</td>
</tr>
<tr>
<td><strong>information</strong></td>
<td>information Information(en) (German)</td>
</tr>
<tr>
<td></td>
<td>tieto (tiedot) (Finnish)</td>
</tr>
<tr>
<td><strong>evidence</strong></td>
<td>evidence Beweis(e) (German)</td>
</tr>
<tr>
<td></td>
<td>todiste(et) (Finnish)</td>
</tr>
<tr>
<td><strong>knowledge</strong></td>
<td>knosi (Greek, dual life) gnosi(s) (Greek, dual life)</td>
</tr>
<tr>
<td></td>
<td>knowledge, Wissen (German)</td>
</tr>
</tbody>
</table>

**tically, and also within languages, we find an interesting parallel between CANs and IONs with respect to the variation in their count/mass lexicalization patterns, namely, that we find count counterparts of object mass nouns. It should be stressed that such variation is not highly widespread in concrete nouns. Sutton and Filip (2016b) identify other classes of nouns where we find this pattern, namely granular nouns such as lentil(-s) in English and čočka (‘lentil’, mass) in Czech (see also Chierchia, 2010), and also the kinds of context-sensitive object nouns that are important data points within Rothstein’s (2010) theory such as fence, and hedge that have intralinguistic mass-counterparts fencing, and hedging. Therefore, it is not insignificant that the class of IONs displays a similar kind of variation.**

**Mass IONs and mass CANs both combine with similar classifiers.** Another property shared by CANs and IONs is that, when they are lexicalized as mass, they can only feature in counting constructions with the same limited number of ‘unit-extracting’ classifiers such as ‘item’ and ‘piece’ (7)-(8).

(7) We bought two new items/pieces of furniture/kitchenware/jewellery.

(8) a. All three items of information are shown in the eyepiece display. [UKWaC]
    b. The snag is that the prospectus must contain pieces of information which rapidly become dated. [BNC]
    c. The third piece of evidence for the big bang is that you can see it. [BNC]
    d. He would dispose of it and a key item of evidence would be gone for good. [BNC]
    e. ... our reason gets from those ideas to certain items of knowledge which others said were innate. [BNC]
    f. ... both pieces of knowledge were essential for survival. [BNC]

**Mass IONs and mass CANs both strongly resist mass-to-count coercion.** The class of object mass nouns (i.e., mass CANs) has also been observed to strongly resist being coerced into count interpretations, either to obtain a ‘unit’ reading (Sutton and Filip, 2016a) or a subkind reading (Grimm and Levin, 2017; Sutton and Filip, 2018), a restriction that is not found in other
concrete or abstract mass nouns:

(9)  a. Two more beers and another fried rice, please.
    b. #I went out to buy three furnitures/jewelleries/footwears.

(10) a. I have two loves/passions: wine and cheese.
    b. #We just learned of three new informations/evidences/knowledges.

We do note, however, that at least one mass ION, knowledge, can be used with the indefinite article, especially when modified (11a). This is not the case for mass CANs, at least in English, or for other mass IONs, which tend to be infelicitous with any determiners that select for count nouns. For example, information, evidence, furniture, and jewellery are all infelicitous with indefinite articles (11b)-(11c).

(11) a. She has a good knowledge of chemistry.
    b. #He gave a good evidence/information in court.
    c. #I saw a good furniture/jewellery while out shopping.

**IONs and CANs overdetermine what counts as one.** Finally, we observe an interesting semantic property of both CANs and IONs, namely that what counts as one N in one context may count as more than one N in another context. For example, for kitchenware, as we see in (12), a pestle and mortar can count as one piece in some contexts, but a proper part, the pestle, can also count as one piece in others. For opinion and statement, it is perfectly felicitous to use either singular or plural forms with the same propositional complement as shown in the corpus examples in (13a) and (14a), and their minimal pairs in (13b) and (14b); however, the same flexibility is not present for concrete nouns such as ball as we see in (15).

(12) a. This $24 ChefSofi Mortar and Pestle is a sturdy piece of kitchenware.  
    b. I need to buy a few pieces of kitchenware: a chef’s knife, a pairing knife, and a new pestle to replace the one I broke.

(13) a. ... the opinion that these two German countries belonged together and that the German people should solve their own internal affairs and difficulties. [UKwaC]
    b. ... the opinions that these two German countries belonged together and that the German people should solve their own internal affairs and difficulties.

(14) a. The Panel is pleased to note the company’s statement that the product is no longer available and that it would not form part of its Christmas 2001 gift range. [UKwaC]
    b. The Panel is pleased to note the company’s statements that the product is no longer available and that it would not form part of its Christmas 2001 gift range.

(15) Alex bought two balls/#one ball: a football and a rugby ball

---

2.3. Three subclasses of IONs

Although there are these four similarities between IONs and CANs, there are, of course, differences. First, their denotations differ. CANs denote physical entities and, when mass, collections thereof. CANs do not denote eventualities, despite the fact that, at least on Grimm and Levin’s (2017) analysis, the lexical semantics of object mass nouns specifies the truth conditions of such nouns in terms of related eventualities (e.g., a furnishing event for *furniture*).

In contrast, all IONs denote (sets of) propositions, something which is evidenced by the fact that, by definition, IONs are felicitous with propositional complements and with predications of truth and falsity. For example, we see evidence that IONs can denote (sets of) propositions in (16a)-(16b). In (16a), the content of Pooh’s belief, a proposition, is true. In (16b), the reference is to contradictory contents of statements made by witnesses, i.e., propositions conveyed by the witnesses.

(16) a. If Pooh’s belief is true, his action (going to the cupboard) will succeed: it will get him the honey he wants. [BNC]
   b. He was acquitted on May 25, 1990, largely because of contradictory statements by witnesses. [BNC]

On top of this proposition-denoting sense, many IONs also have a sense that denotes an eventuality. Indeed, up to this point, we have focussed on the similarities and differences between the classes of CANs and IONs, but IONs do not form a homogenous class. Some IONs have an eventuality denoting sense, but some do not. Also, of those that do, the type of eventuality (STATE or EVENT) differs. Based on these distinctions, we propose that IONs can be divided into three subcategories in terms of their distributional properties. We name these classes based on exemplars of them: (i) statement-like IONs; (ii) belief-like IONs; and (iii) fact-like IONs.

**Statement-like IONs**: Nouns in this group also include *utterance, allegation, declaration*. All can be used to denote EVENTS, as shown for *statement* in (17) and (18). In (17), the restriction concerns making statements (acts of stating), i.e., tokens of a particular eventuality type, and the use of *during* in (18) indicates that the denotation of *statement* is something with a temporal trace (an eventuality).

(17) She had been restricted ... from taking part in public meetings and from making public statements of any kind. [BNC]

(18) In my opinion now an apology would be wasted, it would be the same crocodile tears as we saw during her statement in December [UKWaC]

Also, the basis of grammatical counting can rest for nouns in this class on either eventualities or on propositions as can be seen by assessing the denotation of ‘Alex and Billie’s two statements in the following two contexts:

Context 1a: Alex made a statement that \( p \), and Billie that \( q \).
Context 1b: Alex made a statement that \( p \), and Billie did, too.

An utterance of *Alex and Billie’s two statements* in Context 1a licenses reference to either the eventualities (the stating events) that Alex and Billie were agents of, or to the contents of
their statements (the eventualities). In contrast, the same utterance in Context 1b only licences reference to the eventualities since the contents of Alex and Billie’s statements was the same.

**Belief-like IONs**: This subclass of IONs also includes nouns such as assumption, idea, judgement, knowledge, and thought. As well has being able to denote propositions, nouns in this class also have a sense that denotes a relation to a proposition characterised as some kind of mental state. For example in (19), Galileo is persecuted for having a relation to a particular proposition (that of believing it, a mental state). He was not persecuted for a proposition itself.

(19) At the time, Galileo had just discovered the Galilean moons (including Europa) in Florence but was being persecuted for his belief that the Earth orbits the sun.  

The basis for this extra sense is, we hypothesise, related to but not determined by the fact that they have shared roots with state-denoting verbal predicates (assume, judge, know, think). The reason for this hedge is that idea, insofar as it also has a mental state/attitude-denoting sense, has no cognitive association with a verbal predicate (even if etymologically it is distantly derived from one).

Nouns in this class display a divergence with statement-like IONs insofar as this state-denoting sense does not seem readily available to grammatical counting functions. In Context 2a, the only natural reading of Alex and Billie’s two beliefs is that it refers to the contents of their beliefs (the propositions they believe). However, when we make this reading unavailable as in context 2b, the same utterance is anomalous.

Context 2a: Alex has a belief that $p$ and Billie has a belief that $q$  
Context 2b: Alex has the belief that $p$ and Billie does, too.

Indeed, one must do some work to get any reading in which one can access pluralities of beliefs on the eventuality-denoting reading of belief(s). For example, as discussed in Sutton and Filip (2019), if one provides a plurality of experiencers, but only one proposition in the context, it can be possible to anchor mental states to experiencers and so individuate pluralities of mental states as in (20)

(20) A postal strike in France and the resulting delayed arrival of my dad’s postcard explained my cousins’ beliefs that my he was still in Paris.

**Fact-like IONs**: IONs such as fact, information, intelligence, evidence, and truth, do not seem to have a sense pertaining to an eventuality, and so we assume that they do not have an eventuality argument. In turn, for us, this means that the argument structure of their denotations does not have either an agent or an experiencer. For example, Alex’s information/(pieces of) intelligence/evidence/?fact, if felicitous, seems to evoke a possessor or sender relation, rather than one of an experiencer of a mental state or an agent in an action. An exception to this is possibly evidence which, in a legal setting, can be used to refer to the formal giving of evidence. For example, His evidence lasted for about 40 minutes refers to the hearing of or giving of evidence.

With these nouns, one cannot refer mental states or attitudes, as we see in (21a)-(21b):

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5https://jon-farrow.com/tag/kepler/
It is not coincidental, furthermore, that these nouns either have no shared root with a verbal predicate or have a meaning which is, in some sense, separated from some related verbal meaning. The noun information clearly shares a root with the verbal predicates inform, but the modern uses of this noun seems to be independent from any agentive informing event (something can be information without an agent informing someone of it).

In summary, the classes of IONs and CANs display some interesting distributional parallels that prompt the following thought: theories of the mass/count distinction that can accommodate CANs can provide a basis for a theory that can also accommodate IONs. That said, any such theory would have to be modified, not least to provide an account of how propositions and eventualities are individuated and grammatically counted. In section 3, we put forward such a unified analysis.

3. Analysis: A theory of countability that extends to IONs

3.1. The count/mass distinction for concrete nouns

The theoretical architecture that we assume and briefly summarise here is developed in Sutton and Filip (2016a, b, 2018) and Filip and Sutton (2017). We assume a simply typed truth conditional semantics enriched with classical extensional mereology such that the domain is structured as a Boolean semilattice meaning that we have not only single entities of type $e$, but also sums of entities of type $e$.

The main tenets of Sutton & Filip’s analysis are:

1. An extensional property underpins the distinction between count and mass nouns. The extensional property we assume here is quantization (see below).

2. The lexical entries of count nouns include a context-indexed individuation schema that ensures that a quantized set is available for grammatical counting operations.

Quantized sets (Krifka, 1986; Krifka, 1989) are sets for which no two members are proper parts of each other:

\[ \text{QUA}(P) \iff \forall x \forall y [P(x) \land P(y) \rightarrow \neg x \sqsubseteq y] \]

While the interpretations of count nouns specify quantized sets that can be accessed by grammatical counting operations, the interpretations of mass nouns do not. This alone would already be enough to distinguish count nouns, such as cat, from mass nouns, such as air, on the assumption that the extensions of substance nouns denote cumulative (and so not quantized sets). However, to account for the whole range of data in the mass/count domain, including object mass nouns (mass CANs), such as furniture, and context-sensitive count nouns like fence, which do not lexically specify what is ‘one’ entity across all contexts in a uniform way, we need the notion of context-indexed individuation schemas. (This kind of context sensitivity of individuation has its roots in both the counting contexts of Rothstein (2010) and the variants of Landman (2011).)
Informational Object Nouns and the mass/count distinction

Context-indexed indiavuation schemas, $\mathcal{D}_c$, are functions from sets to maximally quantized subsets thereof. Therefore, even if a predicate $P$ has a non-quantized extension, applying a context-indexed indiavuation schema to this predicate ($\mathcal{D}_c(P)$) at a context $c$ outputs a subset of $P$ that is quantized and is not a subset of a larger quantized subset of $P$:

\[
X \subseteq_{\text{max,QUA}} Y \text{ iff } X \subseteq Y, \text{QUA}(X), \forall Z \subseteq Y[Z \supseteq X \land \text{QUA}(Z) \rightarrow Z = X]
\]

(23)

$$\forall c. \forall P, \mathcal{D}_c(P) \subseteq_{\text{max,QUA}} P$$

For example, if $A = \{\text{pestle}, \text{mortar}, \text{pestle} \sqcup \text{mortar}\}$, then there are two distinguishable functions $\mathcal{D}_c$ and $\mathcal{D}_{c'}$, such that $\mathcal{D}_c(A) = \{\text{pestle}, \text{mortar}\}$ and $\mathcal{D}_{c'}(A) = \{\text{pestle} \sqcup \text{mortar}\}$.

The addition of such indiavuation schemas allows us to characterise, for example, the difference between the English mass CAN kitchenware and the German count CAN Küchengerät-e (`piece-s of kitchenware`). We assume that kitchenware$_w$ is a number neutral predicate (denoting items of kitchenware and sums thereof without the imposition of any indiavuation schema), and that plural morphology is interpreted in terms of Link’s (1983) *-operator (such that $^P$ is the upward closure of $P$ under sum. Following Landman (2011, 2016); Sutton and Filip (2016a); Filip and Sutton (2017); de Vries and Tsoulas (2018), amongst others, we analyze nouns as denoting a bipartite structure that specifies (a) the extension of the noun and (b) a set that is the counting base of the noun. Count nouns have a quantized counting base set, and mass nouns do not. Formally, this is based on the notion of product types in the $\lambda$-calculus. Projections of product types are accessed via projection functions. For ease of presentation, we represent this as labelled frames, as schematised in (25). The counting base set specified in (25) is $\lambda y.P_w(y)$. The extension specified in (25) is $\lambda w.\lambda x.P_w(x)$.

(25) $$\lambda w.\lambda x. \begin{bmatrix} \text{ext} &= P_w(x) \\ \text{cbase} &= \lambda y.P_w(y) \end{bmatrix}$$

The lexical entry of a mass CAN like kitchenware, given in (26), specifies the semantically number neutral predicate kitchenware$_w$ as both its counting base and extension. This means that the property expressed is not countable since, relative to the world of evaluation $w$, the set $\lambda y.\text{kitchenware}_w(y)$ is not quantized.

(26) $[[N \text{kitchenware}]]^c = [[N \text{kitchenware}]] = \lambda w.\lambda x. \begin{bmatrix} \text{ext} &= \text{kitchenware}_w(x) \\ \text{cbase} &= \lambda y.\text{kitchenware}_w(y) \end{bmatrix}$

Singular count CANs are indexed to a schema of indiavuation at every context so that, at the context of utterance, (27) denotes a function from worlds to a quantized set of items of kitchenware. Crucially, this means that the counting base set is quantized; hence, the property expressed is countable. The interpretation of the plural is given in (28) where the counting base set is the same as the singular noun (a quantized set), but the extension is the closure of the extension of the singular noun under mereological sum (i.e., plural count nouns have cumulative extensions).

(27) $[[N \text{Küchengerät}]]^c = \lambda w.\lambda x. \begin{bmatrix} \text{ext} &= \mathcal{D}_c(\text{kitchenware}_w)(x) \\ \text{cbase} &= \lambda y.\mathcal{D}_c(\text{kitchenware}_w)(y) \end{bmatrix}$

(28) $[[N \text{Küchengerät-e}]]^c = \lambda w.\lambda x. \begin{bmatrix} \text{ext} &= ^*\mathcal{D}_c(\text{kitchenware}_w)(x) \\ \text{cbase} &= \lambda y.^*\mathcal{D}_c(\text{kitchenware}_w)(y) \end{bmatrix}$
3.2. Pluralities and individuation schemas across semantic types

In order to be able to apply a similar strategy to capture the IONs data, we need a couple of ingredients. First, we will lay out what domains we assume and what kind of structure we assume they have. Minimally, this will require that we can make sense of pluralities of propositions and eventualities. Second, to define the notion of a context-indexed information schema that applies to entities of any of these types.

For the first part, we assume the notion of type-generalised plural structures developed by Schmitt (2013, 2017). This gives us a generalised mereological sum operation (\(\sqcup\)) operation over different semantic types. For each domain of type \(a\), \(D_a\), we have a bijection function \(pl_a\) on the powerset of \(D_a\) to a plural structure; namely, the set of singularities and pluralities for that domain \(PL_a\) (the inverse of \(pl_a\) is \(pl_a^{-1}\)):

\[
pl_a : (\mathcal{P}(D_a)\setminus\emptyset) \rightarrow PL_a
\]

Predicates with domains on \(PL_a\) are members of the power set of this domain: \(S_a = \mathcal{P}(PL_a)\), namely sets of sets of singularities and pluralities for that domain.

With respect to domains, we assume sets of entities, truth values \(\{0, 1\}\), worlds, and a domain of eventualities that fall under states, processes, and events (in the sense of Bach (1981, 1986), i.a.). This automatically gives us plural structures for these domains (we do not assume there is a use for a plural structure for the domain of type \(t\)). If we add to this the assumption that the domain of propositions is structured as the powerset of the set of worlds, then we can specify plural structures for this domain. Suppose we have three (atomic) possible worlds in our domain: \(w_1, w_2, w_3\), and so three atomic functions of type \(\langle s, t \rangle\) characterised by the singleton sets \(\{w_1\}, \{w_2\}, \{w_3\}\). The set of possible propositions is \(\mathcal{P}(\{w_1\}, \{w_2\}, \{w_3\})\setminus\emptyset\) which is isomorphic to \(PL_{\langle s, t \rangle}\). For example, for some \(p, q, r\), it is the case that \(pl_{\langle s, t \rangle}(\{w_1\}) = p\), \(pl_{\langle s, t \rangle}(\{w_2\}) = q\), and \(pl_{\langle s, t \rangle}(\{w_3\}) = r\). Count and mass predicates that denote sets of propositions can then be distinguished in terms of quantization just as we were able to do for predicates denoting concrete entities. The same strategy also applies to give us plural structures for eventualities.

The second step we need is to generalise our earlier definition of \(\mathcal{D}_c\) to apply to different semantic types. We do this by defining \(\mathcal{D}_c\) to apply to expressions of any type and return a maximally quantized subset thereof (a possibly different set depending on the value of the context, \(c\)).

For all \(c\), for all \(\tau \in \text{type}\), \(\mathcal{D}_c\) is a polymorphic function of type \(\langle \tau, \tau \rangle\)

If \(X\) is a set, the members of which are of type \(a\), then \(\mathcal{D}_c(X) = Y\), such that \(\{y : y = pl_a(y), y \in Y\} \sqsubseteq_{\text{max,QUA}} \{x : x = pl_a(x), x \in X\}\)

For example, applying \(pl_a\) to the members of \(X = \{\{w_1\}, \{w_2\}, \{w_1, w_2\}\}\) yields \(\{p, q, p \sqcup q\}\). Since there are two maximally quantized subsets of this set, \(\{p, q\}\) and \(\{p \sqcup q\}\), there are two distinguishable contexts \(c\) and \(c'\) such that:

\[
\mathcal{D}_c(X) = \{\{w_1\}, \{w_2\}\}; \quad \mathcal{D}_{c'}(X) = \{\{w_1, w_2\}\}
\]

Our type-generalised individuation schema can now also apply to specify maximally quantized
Table 2: Summary of the semantic subclasses of Informational Object Nouns

<table>
<thead>
<tr>
<th>Class</th>
<th>Denotation</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subclass 1</td>
<td>Set of propositions</td>
<td>fact, information</td>
</tr>
<tr>
<td>Subclass 2.1</td>
<td>Relation between entities, propositions and EVENTS</td>
<td>statement, utterance</td>
</tr>
<tr>
<td>Subclass 2.2</td>
<td>Relation between entities, propositions and STATES</td>
<td>belief, knowledge</td>
</tr>
</tbody>
</table>

subsets for the domains of entities, and eventualities as well; this is all that we will need to model the semantics of IONs.

3.3. Lexical entries for IONs

Based on our observations regarding the sub-classes of IONs in section 2.3, we propose two types of lexical entries for IONs: One denoting a set of propositions, the other denoting a relation between entities, propositions, and eventualities. The latter is divisible into two further subclasses depending on whether the eventualities are STATES or EVENTS. These sub-divisions are summarised in Table 2.

**Subclass 1: fact-like nouns**

Nouns in this group denote sets of propositions (they do not encode an associated eventuality). They can be count (fact) or mass (information). As with concrete nouns, we assume that singular count nouns denote quantized sets and are interpreted relative to a context-indexed individuation schema. Mass nouns specify non-quantized counting base sets and are not interpreted relative to a context-indexed individuation schema. Where \( p \) is a variable over the domain of propositions (of type \( \langle s, t \rangle \)), the lexical entry for information is similar to that of kitchenware in (26), except that, relative to a world, the extension of \( [[N \text{ information}]]^c \) is a set of propositions, not of entities.

(30) \[
[[N \text{ information}]]^c = [[N \text{ information}]] = \lambda w. \lambda p. \left[ \begin{array}{c}
\text{ext} = \text{information}_w(p) \\
\text{cbase} = \lambda p'. \text{information}_w(p')
\end{array} \right]
\]

Singular count IONs are indexed to a schema of individuation at every context, so that, at the context of utterance, (31) denotes a function from worlds to a quantized set of items of kitchenware. The interpretation of the plural is given in (32).

(31) \[
[[N \text{ fact}]]^c = \lambda w. \lambda p. \left[ \begin{array}{c}
\text{ext} = \mathcal{Q}_c(\text{fact}_w)(p) \\
\text{cbase} = \lambda p'. \mathcal{Q}_c(\text{fact}_w)(p')
\end{array} \right]
\]

(32) \[
[[N \text{ facts}]]^c = \lambda w. \lambda p. \left[ \begin{array}{c}
\text{ext} = ^* \mathcal{Q}_c(\text{fact}_w)(p) \\
\text{cbase} = \lambda p'. ^* \mathcal{Q}_c(\text{fact}_w)(p')
\end{array} \right]
\]

Similarly, the German count counterpart of information, Information-en (‘piece-s of information’) has a similar structure to facts:

(33) \[
[[N \text{ Information-en}]]^c = \lambda w. \lambda p. \left[ \begin{array}{c}
\text{ext} = ^* \mathcal{Q}_c(\text{information}_w)(p) \\
\text{cbase} = \lambda p'. ^* \mathcal{Q}_c(\text{information}_w)(p')
\end{array} \right]
\]
**Subclass 2.1: statement-like nouns**

Nouns in this group denote relations between entities, propositions, and events. At least in our English data, the primary senses of these nouns tend to be count, however, they can sometimes be used as mass nouns as indicated in (34) which contains both a count and a mass use of *utterance* in the same sentence (the mass use is indicated by the bare singular noun).

(34) What’s all important is the narrative, the sequence of utterances, rather than the volup-
tuousness of utterance itself. [BNC]

Recall that, on their count uses, we can individuate the denotations of these nouns on the basis of either the eventualities they relate to or the propositions that are the contents of the eventuality (performed by some agent). Individuation in terms of propositions will be captured in a similar manner as for count fact-like IONs; namely, the context-indexed individuation function \( \mathcal{D}_v \) will apply to a (non-quantized) set of propositions and return a maximally quantized subset. To explain why we can also individuate in terms of, e.g., stating- or uttering-events, we must appeal to the nature of these kinds of events, namely, that relative to an agent and a propositional contents, such sets of events are quantized. To see this, suppose that \( a \) states that \( p \) and that this eventuality, \( e \), has a run time \( t \). There is no sub-eventuality in which \( a \) also states that \( p \). (Of course, if there are sub-propositions of \( p \), such as \( q \) and \( r \), then there may be \( e', e'' \subseteq e \) such that \( e' \) is a stating \( q \) event and \( e'' \) is a stating \( r \) event). In other words, predicates of such events (more specifically, accomplishments, a subtype of events), restricted in this way, are quantized.

Crucially, when we turn to IONs that denote states (such as belief and knowledge), a similar argument will not apply. That is because states, such as belief-states, hold true for experiencers at relatively long and vague time intervals. If an experiencer has a mental state (e.g., belief) with some propositional contents for some time interval, then they will be in that mental state at any subinterval and moment within that interval. For example, if Ann believes that it is raining during time interval \( i \), then this belief persists at any subinterval and moment of \( i \). Therefore, the set of mental attitude states is not quantized, even if the experiencer and the content of these states are the same.

Turning back to the interpretations of statement-like nouns, where \( p \) is a variable over the domain of propositions (of type \( \langle s, t \rangle \)), and \( e \) is a variable over events, the lexical entry for statement is as in (35).

\[
[[N \; \text{statement}]]^c = \lambda w. \lambda x. \lambda e. \lambda p. \left[ \begin{array}{l}
\text{ext} = \text{statement}_w(e) \land \text{agent}(e)(x) \land \mathcal{D}_c(\text{contents}(e))(p) \\
\text{cbase} = \lambda e'. \lambda p'. \text{statement}_w(e') \land \text{agent}(e')(x) \land \mathcal{D}_c(\text{contents}(e'))(p')
\end{array} \right]
\]

Relative to a world and an agent, we assume that there are two options for how to existentially close the remaining arguments. Either one can existentially close the \( e \) (and \( e' \)) variables, yielding a quantized set of propositions as the extension and the counting base (36), or one can close the \( p \) (and \( p' \)) variables, yielding a set of events as the extension and the counting base (37). This set of events is also quantized.\(^6\)

\[
[[N \; a's \; \text{statement}]]^{c,w} = \lambda p. \exists e. \left[ \begin{array}{l}
\text{ext} = \text{statement}_w(e) \land \text{agent}(e)(a) \land \mathcal{D}_c(\text{contents}(e))(p) \\
\text{cbase} = \lambda e'. \exists e'. \text{statement}_w(e') \land \text{agent}(e')(a) \land \mathcal{D}_c(\text{contents}(e'))(p')
\end{array} \right]
\]

\(^6\)For a proposal for the semantics of subjective genitive expressions containing IONs, see Sutton and Filip (2019)
Informational Object Nouns and the mass/count distinction

(37) \([\lambda e. \exists p. \text{statement}_w(e) \land \text{agent}(e)(a) \land \mathcal{D}_c(\text{contents}(e))(p)]\)  

In other words, an expression such as Alex’s statement is polysemous between denoting a quantized set of events in which Alex stated some proposition and a quantized set of propositions each of which is the contents of some stating event by Alex.

For plural uses of IONs in this class, we assume that the \(^*\)-operator applies to both the set of eventualities and to the set of propositions. The output of this is shown in (38).

(38) \([\lambda w. \lambda e. \lambda p. \text{statement}_w(e') \land \text{agent}(e')(x) \land \mathcal{D}_c(\text{contents}(e'))(p')][\lambda e. \exists p. \text{statement}_w(e) \land \text{agent}(e)(a) \land \mathcal{D}_c(\text{contents}(e))(p)]\)  

The result of this interpretation of plural IONs in this class is that plural uses of nouns such as statements should be polysemous between denoting pluralities of propositions and pluralities of events, and this is the pattern we find in the data (see section 2.3).

We motivate this double application of \(^*\) in the following way. Plural morphology in English, semantically speaking, encodes sum formation. However, this sum formation presupposes a quantized set (i.e., a singular count noun). Where the noun expresses a relation and where this noun is extensionally polysemous between two of its relata (e.g., between events and propositions), the meaning of plural morphology is to generate sums on both of these sets provided that they are both quantized sets. If only one of these sets is quantized, then sum generation will only be on the basis of the quantized set. Where neither of the sets are quantized, application of plural morphology will be infelicitous. As we will argue below, this assumption about the application of plural morphology can explain the different distributional patterns we observed for nouns like statement, belief, and knowledge.

**Subclass 2.2: belief-like nouns**

Nouns in this class also denote relations, however, unlike statement-like nouns that relate agents, events, and propositions, they relate experiencers, states, and propositions. Nouns in this class can be count (belief, opinion) or mass (knowledge). The default reading for nouns in this class is one that denotes propositions, especially when used in the plural or in counting constructions (see section 2). As we argued above, this divergence from the grammatical behaviour of statement-like IONs can be explained on the basis of the fact that, for statement-like IONs, the relevant events relative to an agent and a propositional contents form a quantized set, whereas for belief-like IONs the relevant states, relative to an experiencer and a propositional contents, do not form a quantized set.

Where \(p\) is a variable over the domain of propositions (of type \(s, t\)), and \(s\) is a variable over states, and \(\text{exp}\) is the Experiencer thematic relation, the lexical entry for the count ION belief is as in (39).

(39) \([\lambda w. \lambda x. \lambda s. \lambda p. \text{belief}_w(s) \land \text{exp}(s)(x) \land \mathcal{D}_c(\text{contents}(s))(p)][\lambda e. \exists p. \text{belief}_w(e') \land \text{exp}(e')(x) \land \mathcal{D}_c(\text{contents}(e'))(p')][\lambda e. \exists p. \text{statement}_w(e) \land \text{agent}(e)(a) \land \mathcal{D}_c(\text{contents}(e))(p)]\)
Crucially, given an experiencer, when the \( s \) and \( s' \) arguments are existentially closed, we get a quantized set of propositions, but when the \( p \) and \( p' \) arguments are existentially closed, we get a non-quantized set of states. Also, given our assumptions about plural morphology above, when such IONs are pluralised, as shown in (40), the \(^*\)-operator only applies to the set of propositions. This explains why in most circumstances, when we individuate beliefs, we do so on the basis of their contents and not on the basis of different mental states of the same experiencer.\(^7\) Hence, sentences like Alex’s beliefs that \( p \) and \( q \) cannot get a reading in which the plurality denoted is a plurality of Alex’s mental states, and sentences such as Alex’s beliefs that \( p \) are infelicitous, precisely because there is no plurality of propositions made available, and the set of Alex’s mental states is not quantized leading to an unavailability of any plurality of states generated from a quantized set.

\[
(40) \quad \llbracket I_N \text{ beliefs}]^c = \\
\lambda w.\lambda x.\lambda s.\lambda p. \begin{cases} 
\text{ext} & = \text{belief}_w(s) \land \exp(s)(x) \land ^*\mathcal{D}_c(\text{contents}(s))(p) \\
\text{cbase} & = s'.\lambda p'.\text{belief}_w(s') \land \exp(s')(x) \land ^*\mathcal{D}_c(\text{contents}(s'))(p') 
\end{cases}
\]

For a mass noun in this class such as knowledge, just as we saw for mass nouns in the class of fact-like IONs, there is no context-indexed individuation schema in the lexical entry. This is shown in (41), where we have additional included a veridicality constraint on the meaning of knowledge under the widespread philosophical assumption that knowledge cannot be false. (\(CG_w\) is the set of worlds in the common ground accessible from the world of evaluation.)

\[
(41) \quad \llbracket I_N \text{ knowledge}]^c = \\
\lambda w.\lambda x.\lambda s.\lambda p. \begin{cases} 
\text{ext} & = \text{knowledge}_w(s) \land \exp(s)(x) \land \text{contents}(s)(p) \land \\
\forall w' \in CG_w.\text{contents}(s)(p)(w') = 1 \\
\text{cbase} & = s'.\lambda p'.\text{knowledge}_w(s') \land \exp(s')(x) \land \text{contents}(s')(p') \land \\
\forall w' \in CG_w.\text{contents}(s')(p')(w') = 1 
\end{cases}
\]

Because there is no context-indexed individuation schema in (41), when provided with an experiencer and a world of evaluation, we get neither a quantized set of knowledge-states nor a quantized set of propositions. This predicts that not only will knowledge be infelicitous in counting constructions (see Appendix), it will also be infelicitous with plural morphology since there is no quantized set from which to generate sums of either propositions or knowledge states.

Finally, we turn to a puzzle about mass IONs raised in section 2. There we noted that mass IONs such as information and evidence are highly resistant to any kind of mass-to-count coercion: If placed in any syntactic environment that selects for count nouns, the result is infelicitous. However, knowledge is different. Whereas combining knowledge with numerical expressions (\# three knowledges) is not felicitous, knowledge can be used in at least one count noun environment, namely with an indefinite determiner (11a). While we cannot, here, provide a full analysis of these data, we would like to highlight a possible explanation that is available to us, given our analyses of the different sub-classes of IONs. What distinguishes nouns such as knowledge, on the one hand, from nouns such as information and evidence, on the other, is that only the former specify eventualities as part of their lexical semantics. Hence, one path

\(^7\)Where a plurality of experiencers is specified, but only a simple sentence is given as in (20), one can get a reading where states are individuated in terms of experiencers. For an account of such cases, see Sutton and Filip (2019).
for explaining the fact that knowledge can be used with the indefinite article but information and evidence cannot is that the individuation of knowledge in this context turns on anchoring some set of knowledge states in some way (for a proposal regarding anchoring of psych nouns to events and agents, see Grimm (2014)). Hence, a good knowledge of chemistry would denote some sum of mental states that is selected in terms of an experiencer and the topic to which the contents of these mental states pertains. If this sort of explanation is on the right track, then it would automatically predict the infelicity of a good information/evidence, since neither information nor evidence make available an eventuality in their lexical semantics that can be anchored to something.

4. Conclusion

Providing an adequate theory of the count/mass distinction, even for concrete nouns, is no mean feat, and so it is not surprising that the majority of semantic analyses of countability have focused on concrete nouns to the exclusion of abstract nouns. However, we have argued that it is not a futile endeavour to modify our theories of countability for concrete nouns and so extend their coverage to abstract domains. Central notions in extensional mereological approaches to countability such as quantization can be meaningfully applied to the domains of abstract nouns, such as over propositions. Furthermore, as we have argued, there are interesting and mostly unexplored, parallels between classes of abstract nouns, such as IONs, and classes of concrete nouns, such as CANs, that hint at the possibility of further unifying our semantic analyses of nouns that denote the concrete and the abstract.

References

Appendix: Counting constructions

Here, we give a unified semantics for counting constructions for abstract IONs and concrete nouns. Our analysis can derive interpretations for zwei Informationen (‘two pieces of information’, German), zwei Küchengeräte (‘two pieces of Kitchenware’, German), but rule out two information(s) and two kitchens. We select English and German to show how our analysis captures crosslinguistic facts, however, as we will make clear, clear crosslinguistic pairs of numerical expressions such as two in English and zwei (‘two’) in German will be given the same interpretation (so any infelicity in counting constructions will be explained via properties of the noun). We leave the analysis of counting constructions for relational nouns for further work, and so do not, here, extend this analysis to statement- or belief-like IONs.

Numerical expressions

The interpretations of numerical expressions such as two in English and zwei (‘two’) in German are based on a cardinality function that we define in (42). The cardinality function is relative to a set $P$, and is only defined if this set is quantized. For quantized sets, the cardinality of an entity $x$ with respect to $P$ is the cardinality of the $P$ parts of $x$:

\[
\forall P, \forall x, \mu(x, P) = \begin{cases} 
\{ y : y \subseteq x, P(y) \} & \text{if } \text{QUA}(P) \\
\bot & \text{otherwise}
\end{cases}
\]
In the interpretations of numerical expressions, the relevant set will be the counting base set in the lexical entries of nouns. This gives us the right selectional restrictions for numerical expressions, namely that they can only felicitously combine with count nouns (barring coercion).

We assume that numerical expressions in English and German are of the equivalent of an adjectival (modifier) type (the equivalent in this system of type \(\langle s, \langle et \rangle, \langle s, \langle et \rangle \rangle \)). This is represented in (46). Where \(\mathcal{P} \) is a variable over common noun interpretations such as \([\text{information}], \[\text{information}(en)]\) (‘piece(s) of information’, German), \([\text{kitchenware}]\) and \([\text{Küchengerät-e}]\) (‘piece(s) of Kitchenware’, German). This means that we must assume that \(\mathcal{P} \) is of an underspecified type, i.e., underspecified between the type for entity denoting noun interpretations and proposition denoting noun interpretations. The variables \(\chi, \eta \) are underspecified between type \(e \) and type \(\langle s,t \rangle \). The schema for a noun lexical entry is given in (43).

\[
\lambda w. \lambda \chi. \begin{bmatrix}
ext & = & P_w(\chi) \\
\text{cbase} & = & \lambda \eta. P_w(\eta)
\end{bmatrix}
\]

In addition, we use two projection functions \(\text{CBASE} \) and \(\text{EXT} \) such that:

\[
\begin{align}
\lambda w. \lambda \chi. \text{CBASE}(43)(\chi)(w) & = \lambda \eta. P_w(\eta) \\
\lambda w. \lambda \chi. \text{EXT}(43)(\chi)(w) & = P_w(\chi)
\end{align}
\]

The interpretation of \(\text{two} \) (or equivalently \(\text{zwei} \) in German) can now be stated as follows in (46). This is a function that applies to a common noun and returns an entry with the same counting base set and with an extension that is restricted to only include entities with a cardinality of 2 with respect to the counting base set.

\[
[[\text{Num two}]] = [[\text{Num zwei}]] = \\
\lambda w. \lambda \chi. \begin{bmatrix}
ext & = & \text{EXT}(\mathcal{P}(\chi)(w)) \land \mu_\#(\chi, \text{CBASE}(\mathcal{P}(\chi)(w))) = 2 \\
\text{cbase} & = & \text{CBASE}(\mathcal{P}(\chi)(w))
\end{bmatrix}
\]

**Counting constructions**

This semantics for numerical expressions, i.e. modifiers that restrict the extension of a noun to entities that have a cardinality of \(n \) with respect to the counting base set, automatically selects for count nouns, given the definition of \(\mu_\# \). This means that we can straightforwardly account for the interpretation and felicity of counting constructions with both concrete count nouns and count IONs such as \(\text{zwei Küchengeräte} \) (‘two pieces of Kitchenware’, German) and \(\text{zwei Informationen} \) (‘two pieces of information’, German), respectively. The derivations for these are based on (46) and the entries for \(\text{Küchengeräte} \) (28) and \(\text{Informationen} \) (33) in section 3

\[
\begin{align}
[[\text{Nump zwei Küchengeräte}]] & = [[\text{Num zwei}]]([[[N Küchengeräte]]]) = \\
\lambda w. \lambda \chi. \begin{bmatrix}
ext & = & \mathcal{Q}_e(\text{kitchenware}_w)(x) \land \mu_\#(x, \mathcal{Q}_e(\text{kitchenware}_w)) = 2 \\
\text{cbase} & = & \lambda y. \mathcal{Q}_e(\text{kitchenware}_w)(y)
\end{bmatrix}
\end{align}
\]

\[
\begin{align}
[[\text{Nump zwei Informationen}]] & = [[\text{Num zwei}]]([[[N Informationen]]]) = \\
\lambda w. \lambda p. \begin{bmatrix}
ext & = & \mathcal{Q}_e(\text{information}_w)(p) \land \mu_\#(x, \mathcal{Q}_e(\text{information}_w)) = 2 \\
\text{cbase} & = & \lambda q. \mathcal{Q}_e(\text{information}_w)(q)
\end{bmatrix}
\end{align}
\]

For the English mass CAN and mass ION cases (#two kitchenwares/informations), composition with \([[\text{Num two}]]\) is ruled out since the counting base sets of \([[N \text{ kitchenware}]]\) and \([[N \text{ information}]]\) are not quantized, and so the use of these sets with \(\mu_\# \) is undefined.
The Finnish partitive in counting and measuring constructions

Peter R. SUTTON — Heinrich-Heine-Universität, Düsseldorf
Carol-Rose LITTLE — Cornell University

Abstract. This paper proposes a compositional semantic analysis for the use of the partitive case in counting and measuring constructions in Finnish. Count nouns in counting constructions are partitive singular but partitive plural in measure constructions. Mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We propose an analysis for this pattern by making the semantics of the partitive morpheme both (i) derived from the notion of mereological parthood and (ii) sensitive to quantization. Finally, we show how this analysis extends to account for why mass nouns and plural count nouns in partitive case are felicitous as partitive subjects, when singular count nouns in partitive case are not.

Keywords: Finnish, partitive case, mass/count, indefiniteness.

1. Introduction

In this paper we propose an analysis for the Finnish partitive case in counting and measuring constructions. In (1a), we see that count nouns like ‘apple’ are in the partitive case after numerals. Mass nouns such as ‘rice’ in (1b) are infelicitous with numerals. In the measure construction in (2), mass and count nouns are both in the partitive case, as in (2a) and (2c), but the count noun additionally has the plural marker. Without the plural morpheme, the count noun is infelicitous in the measuring construction (2b).

\[(1)\quad \begin{align*}
a. \text{kaksi omena-} & \quad b. \text{#kaksi riisi-} \\
\text{two \ partitive} & \quad \text{two \ rice-} \\
\text{apple} & \quad \text{PART} \\
\text{two \ apples} & \quad \text{Intended: ‘two (portions/grains of) rice’}
\end{align*} \]

\[(2)\quad \begin{align*}
a. \text{kaksi kilo-} & \quad \text{b. #kaksi kilo-} \\
\text{two \ kilo-} & \quad \text{two \ kilo-} \\
\text{omeno-} & \quad \text{omeno-} \\
\text{i-ta} & \quad \text{PART} \\
\text{two \ kilo-} & \quad \text{two \ kilo-} \\
\text{PART \ apple} & \quad \text{PART \ apple} \\
\text{PL-} & \quad \text{PL-} \\
\text{PART} & \quad \text{PART} \\
\text{‘two \ kilos \ of \ apples’} & \quad \text{‘two \ kilos \ of \ apples’} \\
\text{‘two \ kilos \ of \ apples’} & \quad \text{Intended: ‘two \ kilos \ of \ apples’}
\end{align*} \]

\[(2c)\quad \begin{align*}
\text{c. kaksi kilo-} & \quad \text{two \ kilo-} \\
\text{riisi-} & \quad \text{rice-} \\
\text{i-ta} & \quad \text{PART} \\
\text{two \ kilo-} & \quad \text{two \ kilo-} \\
\text{rice \ PART} & \quad \text{rice \ PART} \\
\text{‘two \ kilos \ of \ rice’} & \quad \text{‘two \ kilos \ of \ rice’}
\end{align*} \]

1We would like to thank comments and discussion from audiences at Sinn und Bedeutung 24, SinFonIJA , ThiLLC 13 and the Potsdam University SynSem Colloquium. Thanks, also, to Eleni Gregoromichelaki and Malte Zimmermann for helpful discussions. Unless otherwise cited, data comes from consultation with Finnish: An essential Grammar (Karlsson, 2018) and native speakers, primarily from the Helsinki metropolitan area, particularly Markus Hippi, Silva Kirikomäki and Sami Kumpula (Kiitoksia!). Funding for the first author was from the DFG CRC 991 project The Structure of Representations in Language, Cognition, and Science, project C09, A frame-based analysis of countability. Funding support for the second author is possible thanks to the Cognitive Science Program at Cornell University.

2Abbreviations: 1 = first person; 3 = third person; ADESS = adessive; ALLAT = allative; GEN = genitive; ELAT = elative; INESS = inessive; N = noun; PART = partitive; PL = plural; PST.P = past participle suffix; SG = singular.

The pattern in Finnish is surprising given the typology across other number marking languages. Usually count nouns are either plural in both counting and measuring constructions, as in English in (3), or both singular as in Turkish in (4).

(3) English
   a. two apples  b. two kilos of apples

(4) Turkish
   a. iki elma       b. iki kilo elma
two apple         two kilo apple
‘two apples’      ‘two kilos of apples’

Finnish, on the other hand, employs different strategies for counting and measuring constructions. While omena-a ‘apple-PART’ is in the partitive singular in (1a), in measuring constructions, the count noun takes the partitive plural (2a). Mass nouns are infelicitous in counting constructions (1b) but in the partitive singular in measuring constructions (2c).

This data presents a puzzle. On the assumption that nouns in counting constructions denote cumulative predicates, or single entities and sums thereof, omena-a (‘apple.SG-PART’) in (1) denotes a cumulative predicate, even though it is singular. Measure phrases, such as kilo-a ‘kilo-PART’ in (2), select for cumulative predicates. Therefore, singular nouns in partitive case in Finnish should be felicitous in measure constructions because they denote cumulative predicates—but they are not.

In this paper, we propose a compositional semantic analysis for the singular and plural partitive constructions in Finnish in (1-2). We argue that each morpheme contributes to the semantic interpretation, in contrast to Ionin and Matushansky (2004) and Ionin et al. (2006) who assume PL morphology is semantically vacuous. We propose a solution to this puzzle that analyses the Finnish partitive as semantically sensitive to both the semantic type of the nominal predicate it applies to and to whether or not type \( \langle e, t \rangle \) predicates are quantized (QUA) in the sense of Krifka (1989).

The goal of this paper is therefore to account for the distribution of the partitive singular and plural in counting and measuring constructions (1) and (2), namely: (i) count nouns in counting constructions are partitive singular but partitive plural in measure constructions; and (ii) mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We do this by making the semantics of the partitive morpheme both (i) derived from the notion of mereological parthood; and at the same time (ii) sensitive to quantization. Bare singular count nouns denote quantized predicates, mass nouns and plural count nouns denote non-quantized predicates. We argue that the partitive morpheme is polysemous and is interpreted with a different sense depending on whether the predicate it applies to is quantized.

While previous accounts of the Finnish partitive include Kiparsky (1998), who focuses on the partitive and aspect, and Danon (2012), who takes a syntactic approach to counting constructions, these accounts do not obviously extend to measure constructions. To our knowledge, there is no compositional analysis of the partitive morpheme in Finnish that accounts for counting and measuring constructions.

This paper is structured as follows. We first give background on the partitive case and provide
evidence that Finnish has a grammaticalized mass/count distinction (§2). We then provide background on counting and measuring constructions crosslinguistically (§3) and show why this makes the Finnish data all the more puzzling. §4 briefly reviews some previous accounts of the Finnish partitive. In §5, we propose an analysis for the partitive in counting and measuring constructions. In §6, we show how our account also predicts a key distributional fact about partitive subjects. §7 concludes the paper.

2. Background on the partitive case and mass/count distinction in Finnish

2.1. The partitive case

The partitive is a nominal case marker that roughly conveys a meaning related to parthood, nonspecificity, or something without result, and is common across Finnic languages. The partitive singular has three endings: -a/-ä, -ta/-tä, or -tta/-ttä, where the vowel of the partitive suffix assimilates to vowels in the root. The partitive plural is built by adding -i/j to the stem and then the partitive ending (Table 1). While there are other uses of the partitive, here we focus on counting and measuring constructions.

<table>
<thead>
<tr>
<th>N Concept</th>
<th>N-NOMINATIVE</th>
<th>N-PARTITIVE</th>
<th>N-PL-PARTITIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>apple</td>
<td>omena</td>
<td>omena-a</td>
<td>omeno-i-tä</td>
</tr>
<tr>
<td>language</td>
<td>kiel</td>
<td>kiel-tä</td>
<td>kiel-i-ä</td>
</tr>
<tr>
<td>room</td>
<td>huone</td>
<td>huone-tta</td>
<td>huone-i-tä</td>
</tr>
<tr>
<td>ball</td>
<td>pallo</td>
<td>pallo-a</td>
<td>pallo-j-a</td>
</tr>
</tbody>
</table>

2.2. Evidence for a mass/count distinction in Finnish

Finnish has a lexicalized count/mass distinction, exhibited by the following contrasts with the quantifiers monta (5) and paljon (6) and the distributive determiner jokainen (7). For instance, the count noun pallo ‘ball’ is felicitous with the quantifier monta (5a), but the mass noun riisi ‘rice’ is not (5b). Similarly, the quantifier paljon is felicitous with count nouns like ihminen ‘person’ in the partitive plural but not singular (6a). Mass nouns are felicitous with paljon in the partitive singular but not plural (6b).

(5) a. Kuinka monta pallo-a on laatiko-ssa?
   how many ball-PART be.3 box-INESS
‘How many balls are in the box?’

b. #Kuinka monta riisi-iä on pakkaukse-ssa?
   how many rice-PART be.3 package-INESS
   ‘#How many rice(s) is/are in the package?’

(6) a. Tuo-llä on paljon #ihmis-tä / ihmis-i-ä.
that-ADESS be.3 a.lot.of person-PART / person-PL-PART
‘There is/are a lot of #person/people over there.’

b. Pakkaukse-ssa on paljon riisi-iä / #riise-j-ä
package-INESS be.3 a.lot.of rice-PART / rice-PL-PART
‘There is/are a lot of rice/#rices in the package.’
    each golden ring cost-3 over 200 euro-PART
    ‘Each gold ring costs over 200 euros.’

    b. #Jokainen kulta maksa-a yli 200 euro-a.
    each gold cost-3 over 200 euro-PART
    ‘#Each gold costs over 200 euros.’

We take the data in (5-7) as evidence for a mass/count distinction in Finnish.

3. The puzzle of Finnish counting and measuring constructions

Given that one of the contrasts in the Finnish data that we are focussing on are counting constructions such as (1a) and measuring constructions such as (2a,2c), one possible hypothesis to explain the distributional patterns of the Finnish partitive case and number morphology in such examples would be that they can be derived from syntactic and semantic differences between counting and measuring constructions that are witnessed cross-linguistically. Although we do not dispute that there are such differences, we argue that this hypothesis does not account for the Finnish data. Indeed, the Finnish data presents a puzzle regarding the meanings of nouns in counting and measuring constructions.

3.1. The counting/measuring distinction does not underpin the Finnish data

Rothstein (2011, 2016, 2017), based upon data from English, Hebrew, and Mandarin, proposes that the syntax of counting constructions (8,9), is distinct from the syntax of measure constructions (10). Furthermore, this structural difference underpins a semantic distinction, for example, whether the numeral is adjectival (counting constructions), or a type n argument to a measure function (measure constructions).

(8) \[
\text{DP} \quad \text{[D three]} \quad \text{[NumP} \quad \text{[Num three] [NP apples] ]]}
\text{Count (direct)}
\]

(9) \[
\text{DP} \quad \text{[D three]} \quad \text{[NumP} \quad \text{[Num three] [NP \text{ boxes} (of) [NP apples] ]]}
\text{Count (container)}
\]

(10) \[
\text{NP} \quad \text{[MeasP} \quad \text{[Num three] [Nmeas kilos] (of) [NP apples] ]]}
\text{Measure}
\]

However, the syntactic/semantic distinction between counting and measuring constructions does not underlie the pattern we see in Finnish with respect to nouns such as omena ‘apple’. We repeat (1a) and (2a) below as (11) and (13), respectively. The count container construction is given in (12). If the pattern we find in the Finnish data were to be explained on the basis of a distinction between counting and measuring, we would expect (11) and (12) to pattern together, and (13) to pattern differently. However, what we actually find is that (12) and (13) pattern together in Finnish, with (11) showing the distinct pattern of requiring the noun to be singular and in the partitive case. Therefore, it cannot be that the counting/measuring distinction explains why omena (‘apple’) must be plural in (12) and (13) but cannot be plural in (11).

(11) \[
\text{kaksi omena-a}
\text{two apple-PART}
\text{‘two apples’}
\]

\[\text{Constructions such as those in (9) do also have a measure interpretation, albeit with a different syntactic structure (Rothstein, 2011). On this interpretation (9) means, approximately, apples to the measure of three boxes-worth as opposed to the count (container) interpretations which is three boxes, each containing apples.}\]
Crosslinguistically, the Finnish pattern is distinctive in this way. As shown in Table 2, in Germanic languages such as English and German, counting constructions (formed with numerals greater than one) require plural marked nouns and so do measure constructions. In Turkish (Turkic) and Hungarian, singular count nouns are licensed in counting constructions with any numeral and likewise with measure constructions. Only Finnish (and other Finnic languages) display a pattern where direct counting licenses singular nouns (in partitive case), where container constructions and measure constructions require count nouns to be plural (and in partitive case).

Table 2: Distribution of PL and SG marking in counting and measuring constructions

<table>
<thead>
<tr>
<th>Phrase type: Count: direct</th>
<th>Count: container</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>N concept:</td>
<td>apple</td>
<td>box</td>
</tr>
<tr>
<td>English</td>
<td>PL</td>
<td>PL</td>
</tr>
<tr>
<td>German</td>
<td>PL</td>
<td>PL</td>
</tr>
<tr>
<td>Turkish, Hungarian</td>
<td>SG</td>
<td>SG</td>
</tr>
<tr>
<td>Finnish</td>
<td>SG.PART</td>
<td>SG.PART</td>
</tr>
</tbody>
</table>

3.2. The puzzle

The three distinct patterns just discussed give rise to the puzzle that is the central focus of this paper. On the assumption that, at least for English/German-type number marking languages, plural morphology is not semantically vacuous, we have a situation where counting with numerals greater than one requires count nouns to be in the plural, since singular count nouns do not denote sums of entities. Given that measure phrases such as two kilos (of) select for nouns denoting cumulative predicates (nouns which denote entities and all possible sums thereof), it is also not surprising that count nouns in measure constructions must also be in the plural. Turkish and Hungarian show a different pattern. In these languages, singular count nouns seem capable of denoting not only atoms, but also sums as we see in the Turkish example in (14) (Alexiadou, 2019: p. 128).⁴

(14) Kitap al-di-m
    book buy-PAST-1SG
    ‘I bought a book/books’

⁴See Farkas and de Swart 2010 for a defence of this view for Hungarian
This explains why singular count nouns are felicitous in counting constructions and in measure constructions as complements to measure phrases. Finnish, puzzlingly, displays neither pattern. Were it the case that singular count nouns in partitive case denoted entities and sums thereof, we would expect singular count nouns in Finnish to be felicitous as complements to measure phrases such as *kaksi kilo-a* (two kilo-PART), but they are not. The puzzle, then, in simple terms, is why are singular count nouns in partitive case felicitous in counting constructions but not measure constructions?

4. Previous analyses of the Finnish partitive

There is not a large amount of work done on counting and measuring constructions in Finnish in the formal semantics literature. Most work has focussed on the relation between the partitive case and aspect (Krifka, 1992; Kiparsky, 1998; Filip, 1999; Kratzer, 2004). Here, we briefly review the relevant claims that have been made and also highlight the ways in which our proposal differs from them.


The key semantic notion for Kiparsky is unboundedness. A predicate *P* is unbounded (approximately) iff non-atoms of *P* have *P*-parts, non-maximal (suprema) of *P*s are parts of some *P*, and at least some *P* are proper parts of other *P*s (*P* is not quantized in the sense of Krifka (1989)).

Unboundedness is combined with the following claims:

15. A VP predicate is unbounded if it has either an unbounded head or an unbounded argument. (Kiparsky, 1998: §5)

16. The object of an unbounded VP is obligatorily partitive.

Kiparsky (1998) does not specifically address counting and measuring constructions in the kinds of contexts we have considered. Instead, counting constructions are only considered as objects to verbs that licence genitive/nominative-partitive alternation insofar as NPs such as *kaksi karhu-a* (‘two bear-PART’) are bounded (for example, no sum of two bears is a proper part of a sum of two bears). Other examples of unbounded NPs are plural count noun NPs and mass noun NPs.

Partitive subjects, for Kiparsky, are VP internal subjects: “In its NP-related function, partitive case is assigned to quantitatively indeterminate NPs (including indefinite bare plurals and mass nouns)” (Kiparsky, 1998: §1). “On subjects, partitive case marks the unboundedness of the NP itself” (Kiparsky, 1998: §7). In other words, for intransitive verbs, unboundedness of the VP is determined by the NP. This means that only mass noun NPs and plural count noun NPs can be partitive subjects.

While a combined analysis of NP and VP uses of the partitive explains why SG count nouns do not take partitive case when in subjects and why partitive subjects are only found with

---

5 There is more work done on the syntax of counting constructions. Much of this work argues that partitive case is structural (e.g. Vainikka 1989; Vainikka and Maling 1996; Nelson 1998), not inherent, or that numerals assign partitive case to nouns (e.g. Danon 2012). Belletti (1988) argues that the partitive case in Finnish is an inherent case. Here, we explore the extent to which partitive case can be viewed as making a systematic contribution to the meaning of counting and measuring constructions.
intransitive verbs, it does not obviously explain why we should find partitive case used in counting constructions (unless it is assumed that it is assigned by the numeral). It also does not explain why partitive subject NPs have an indefiniteness effect, as we will see below.

On our analysis, in contrast to Kiparsky, we will treat the partitive case, not as structural and merely conveying some semantic property of an NP or VP in which the case is used. Instead, we assign the partitive morpheme with a semantics that interacts with the semantic properties of nouns on which case is marked in interaction with independently motivated semantic properties of numerals and measure expressions.

4.2. Danon (2012)

Although Finnish is not the main focus, Danon (2012) analyses the partitive case in counting constructions as being assigned to the noun by the numeral. This is based on his analysis for numerals, number marking, and the structures of numeral-noun-complexes found across languages. He remarks on the puzzle of why the partitive plural may not appear on nouns in counting constructions. To account for this, he proposes a possible explanation where partitive plural is ruled out due to structural competition of number marking (NumP), making (17) ungrammatical: “[h]aving an embedded NumP which is both plural and partitive might then be blocked either for semantic reasons or due to a structural competition for the Num[ber marking] position, making the following recursive structure ungrammatical” (Danon, 2012: p.1305).

(17) *

While Danon proposes a possible syntactic explanation for the occurrence of SG.PART Ns in counting constructions, he does not extend it to measure constructions. So far, to our knowledge, no formal semantic account of the distribution of plural and partitive morphology in counting and measuring constructions has been given.

4.3. Krifka (1992)

One of the few accounts that treats the Finnish partitive as meaning-conveying is presented in Krifka (1992) (but see also Belletti, 1988; Filip, 1999). Here, as in Kiparsky’s work, the focus is on nominative/genitive-partitive case alternations and their impact on aspect, however, part of Krifka’s proposal will be incorporated into our approach below.

Krifka (1992) draws a parallel between the meaning of progressive verbal morphology in languages such as English and the meaning of partitive morphology in Finnish:

\[ PROG_{Krifka} = \lambda P_{(v,t)} \lambda e' \exists e[P(e) \land e' \sqsubseteq e] \]

\[ PART_{Krifka} = \lambda P_{(v,t)} \lambda x' \exists x[P(x) \land x' \sqsubseteq x] \]

In words, both PROG and PART are functions that apply to predicates and return a set of parts of some entity/eventuality in that predicate’s denotation.

For aspect-related uses of the Finnish partitive, Krifka derives PROG applying at the VP level from PART applying at the DO DP level. We do not give the full details here, but the intuitive idea is as follows: For VPs such as söi omen-a (‘ate apple-PART), [söi][PART([omena])] means
that part of an apple is eaten. From this, we can infer that the event in which the part of the apple was eaten is a part of some presumed eating-a-whole-apple eventuality. In other words, someone was eating an apple (a progressive, atelic reading).

While we do not comment here on the connection between aspect and partitive morphology, part of our analysis for PART will adopt much of the spirit of Krifka’s notion of a set of parts of some P. On our analysis, however, partitive morphology will encode the notion of proper P-parts of some P.

5. Analysis: Counting and measuring constructions in Finnish

To briefly recapitulate, the goal of this paper is to account for the distribution of partitive case morphology in interaction with singular/plural plural morphology in counting and measuring constructions, repeated in (18) and (19), namely to explain why count nouns in counting constructions are partitive singular but partitive plural in measure constructions, and why mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. From this explanation, and from some relatively standard assumptions about the semantics of DPs, we will also then derive an important restriction on the distribution of partitive subjects.

(18) a. kaksi omena-a
two apple-PART
‘two apples’
b. #kaksi riisi-a
two rice-PART
Intended: ‘two (grains of) rice’

(19) a. kaksi kilo-a riisi-a
two kilo-PART rice-PART
‘two kilos of rice’
b. kaksi kilo-a omeno-i-ta
two kilo-PART apple-PL-PART
‘two kilos of apples’
c. #kaksi kilo-a omena-a
two kilo-PART apple-PART
Intended: ‘two kilos of apples’

5.1. Formal preliminaries

Throughout, we assume a classical extensional mereological semantics (CEM) in which the domain of type e forms a Boolean semilattice (contains both individual entities and sums thereof) minus the 0 element. (See Link (1983); Krifka (1989); Champollion and Krifka (2016) among many others.) In CEM, we have a complete, commutative, idempotent, and associative mereological sum operation \( \sqcup \) (see Krifka, 1989), where for any two entities of type e, \( a \sqcup b \), the sum
of \( a \) and \( b \) is also of type \( e \). Other standard definitions are given below:

\[
\begin{align*}
(20) & \quad a \sqsubseteq b \iff a \sqcup b = b & \text{part} \\
(21) & \quad a \sqsubset b \iff a \sqsubseteq b \land x \neq y & \text{proper-part} \\
(22) & \quad AT(P) := \{ x : P(x), \forall y.P(y) \to \neg y \sqsubset x \} & \text{\( P \)-atoms} \\
(23) & \quad ^*P := \{ x : Y \subseteq P, x = \sqcup Y \} & \text{upward closure of \( P \) under \( \sqcup \)}
\end{align*}
\]

5.2. The partitive morpheme in counting and measuring constructions

Building on Krifka (1992), we propose that the one common thread that underpins many uses of the partitive morpheme in Finnish is that of \( P \)-parts of entities:

\[
(24) \quad \text{PartSet}(x, P) := \{ y : y \sqsubseteq x, P(y) \}
\]

In words, \( \text{PartSet}(x, P) \) is the set of entities that are parts of \( x \) and are \( P \)s.

In the rest of this section, we show how the notion of \( \text{PartSet} \) plays a role in counting and measuring constructions.

5.2.1. \( \text{PartSet} \) and counting constructions

For languages such as English, counting constructions such as \textit{two apples} are typically analysed as sets of entities, where each member of this set is a sum of two apples. More formally, the set of entities that has a cardinality of 2 with respect to the set of single apples \( \langle \lambda x.\mu_#(x,\text{apple}) = 2 \rangle \), such that each member of this set is a single apple or a sum thereof \( ^*\text{apple} \).

\[
(25) \quad [\text{two apples}] = \lambda x. [\mu_#(x,\text{apple}) = \{ \{ y : y \sqsubseteq x, y \in P \}\} \text{ if } QUA(P) \perp \text{ otherwise}]
\]

Compositionally, the numeral is treated as adjectival (either type \textit{et} or type \( \langle\langle e, t\rangle, \langle e, t\rangle\rangle \)) and as encoding a cardinality function \( \mu_# \). Depending on one’s theory, the cardinality function is restricted in some way such that it is only defined for count nouns. Here, we take Krifka’s notion of a quantized predicate. A predicate, \( P \) is quantized (\( QUA(P) \)) iff no two things in the extension of \( P \) are proper parts of each other.

\[
(26) \quad QUA(P) \iff \forall x,y.P(x) \land P(y) \rightarrow \neg x \sqsubset y
\]

The property \( QUA \) then is used to define the felicity conditions on what can be a restriction on the cardinality function:

\[
(27) \quad \mu_#(x, P) = \begin{cases} 
\{ \{ y : y \sqsubseteq x, y \in P \}\} & \text{if } QUA(P) \\
\perp & \text{otherwise}
\end{cases}
\]

The reason we need some restriction is to avoid unintuitive results derived from double counting. Suppose that \( P = \{ a, b, a \sqcup b \} \), a non-quantized predicate. Without the restriction that \( P \) is quantized, we get an unintuitive counting result: \( \mu_#(a \sqcup b, P) \) would equal 3, not the more intuitive 2 or 1 (we would be counting \( a, b \) and \( a \sqcup b \) each as individual \( P \)s).
Interestingly, the definition for $\mu_{#}(x, P)$ in (eq:cardfunc2) is actually based on $PartSet$:

$$
\mu_{#}(x, P) = \begin{cases} 
|PartSet(x, P)| & \text{if } QUA(P) \\
\bot & \text{otherwise.}
\end{cases}
$$

In English, the derivation for a counting construction such as two apples would then be roughly as follows (although details vary depending on the details of one’s analysis).\(^6\)

$$
\begin{align*}
\text{[two]} &= \lambda P. \lambda x. \mu_{#}(x, AT(P)) = 2 \\
\text{[apple]} &= \lambda x. \text{apple}(x) \\
\text{[PL]} &= \lambda P. *P \\
\text{[apples]} &= \text{[PL]}(\text{[apple]}) = \lambda x. *\text{apple}(x) \\
\text{[two apples]} &= \lambda x [\mu_{#}(x, \text{apple}) = 2 *\text{apple}(x)]
\end{align*}
$$

For a language in which singular count nouns have number neutral denotations (denoting single entities and sums thereof), the derivation would be more or less the same, save the application of $[\text{PL}]$.

Such an analysis cannot work for Finnish, however, since grammatical Finnish counting constructions contain singular count nouns in partitive case not plural count nouns. As a first pass, then, we could assume that the sense in which the basic meaning of partitive morphology ($PartSet$) contributes to counting constructions is build a frame for a counting construction that combines the meaning of the argument noun with a numeral.

$$
\text{[PART\_1st\_pass]} = \lambda P. \lambda n. \lambda x. [\mu_{#}(x, P) = n \land x = \sqcup(\text{PartSet}(x, P))]
$$

In words, a function that is supplied with a predicate and a numeral of type $n$ yields the set of entities that have a cardinality of $n$ each of which is identical to the sum of its $P$-parts. Notice, in particular that the notion of $PartSet$ is used both to determine cardinality of $x$ (see (28)) and to further restrict the extension of the set.

Now, as it happens, when the 0-element is not part of the domain, (34), the following equivalence holds:

$$
\text{[PART\_1st\_pass]} = \lambda P. \lambda n. \lambda x. [\mu_{#}(x, P) = n \land x = \sqcup(\text{PartSet}(x, P))]
$$

In other words, $PartSet$ can play a central role in both defining a cardinality function and restricting membership of a set to $P$s and sums thereof. Put another way, the partitive morpheme, based on $PartSet$, can yield a means of compositionally deriving counting constructions in Finnish that take only singular count nouns as arguments.\(^7\) In other words, we have a derivation for counting constructions in Finnish that selects for singular nouns in partitive case such as in kaksi omena-a (two apple-PART, *two apples):

$$
\begin{align*}
\text{(a) [kaksi]} &= 2 \\
\text{(b) [omena]} &= \lambda x [\text{apple}(x)] \\
\text{(c) [riisi]} &= \lambda x [\text{rice}(x)]
\end{align*}
$$

---

\(^6\) In particular, the way in which the restrictor set for $\mu_{#}$ is determined is disputed. Here, since our aim is not to analyse English, we use $AT(P)$ just by way of demonstration.

\(^7\) There are similarities between this and the proposal in Ionin and Matushansky (2004); Ionin et al. (2006) for numerals in English and Finnish. The distinction between our proposals is that we do not assume that plural morphology is semantically vacuous in either English or Finnish. We also think there is evidence that Finnish numerals in nominative counting constructions are not of an adjectival type, since, if they were, we would expect the numeral and the noun to have the same case.
(37) \[\text{omena-a} = \text{[PART]}(\text{[omena]})\]
\[\lambda n. \lambda x. [\mu_\#(x, \text{apple}) \land \sqcup \text{(PartSet}(x, \text{apple})) = x]\]

(38) \[\text{kaksi omena-a} = \text{[PART]}(\text{[omena]})\(\text{[kaksi]}\)
\[\lambda n. \lambda x. [\mu_\#(x, \text{apple}) = n \land \sqcup \text{(PartSet}(x, \text{apple})) = x]\]

Count nouns in nominative case (singular or plural) and mass nouns in nominative case are ruled out from counting constructions, since they are of type \(\langle e, t \rangle\), and so cannot compose with the numeral of type \(n\). Mass nouns in partitive case such as riisi-ä (‘rice-PART’) are ruled out since \[\text{riisi}] is not quantized and so \[\mu_\#(x, \text{[riisi]})\] is not defined.

5.2.2. PartSet and measure constructions

The reason why \text{PART}_1\text{st pass} is not sufficient is that it makes the wrong predictions for measure constructions. Recall that grammatical measure constructions contain (singular) mass nouns in partitive case and plural count nouns in partitive case, but, as it stands, \text{PART}_1\text{st pass} is not defined for either plural count or mass noun predicates. We therefore propose a polysemous interpretation for \text{PART} that ‘fills the gap’ by defining \text{PART} for predicates that \text{PART}_1\text{st pass} in (34) and (35) is not defined for. One polyseme for \text{PART} is as in \text{PART}_1\text{st pass}, the second polyseme for \text{PART} will, like \text{PART}_1\text{st pass}, be based on \text{PartSet}. Our inspiration for this is Krifka’s (1992) proposal (see section 4.3).

\[\text{[PART]} = \{\]
\[(39a) \quad \lambda P. \lambda n. \lambda x. [\mu_\#(x, P) = n \land \sqcup \text{(PartSet}(x, P)) = x]\]
\[(39b) \quad \lambda P. \lambda x. \exists y. [P(y) \land x \in \text{PartSet}(y, P) \land x \neq y]\]

When supplied with a predicate, \(P\), the polyseme for \text{PART} in (39b) yields the set of entities that are \(P\)s or sums of \(P\)s but are not maximal in the context, i.e., not \(\sqcup P\). In other words, (39b) applies to some set of entities or stuff and returns a proper subset of these entities, namely, everything other than the sums of entities or stuff which are not proper parts of anything else in the set.

Now, it is worth emphasising that these two senses of \text{PART} are in a pseudo-complementary distribution in the following sense. As we have shown, (39a) is only defined for predicates denoted by singular count nouns i.e., quantized predicates. However, (39b) returns the empty set if applied to predicates denoted by singular count nouns. It returns a non-empty set if applied to predicates denoted by plural count nouns and mass nouns, i.e. non-quantized predicates. This is because (39b) requires that there is at least one \(P\) that has a \(P\)-part not identical with itself, i.e., that there are at least two \(P\)s such that one is a proper part of the other.

By adopting this semantics for \text{PART}, we are almost able to derive the right results for measure constructions. There is, however, a wrinkle that we will only briefly address here. Measure constructions in Finnish also contain partitive case on the measure expression (e.g. \text{kilo-a} (‘kilo-PART’)). On standard assumptions, measure expressions such as \text{kilo} would be of type
The Finnish partitive in counting and measuring constructions

The Finnish partitive in counting and measuring constructions (Rothstein, 2011) or of type \((n, \langle e, t \rangle, \langle e, t \rangle)\), but if kilo-a (‘kilo-PART’) were also of this type, partitive morphology on measure expressions would be semantically vacuous. Although not an optimal outcome, given that we are providing a semantic analysis of partitive morphology, this could be explicable in the following way. Since, for example, \([\text{kilo}]([\text{kaksi}])\) would be of an adjectival type, and since adjectives in Finnish display case agreement with the nouns they modify, partitive morphology on kilo is a matter of case agreement.

An alternative, more semantically driven approach would be to assume that, just as partitive morphology introduces a cardinality function on nouns, it introduces a measure function on a scalar concept such as \(\text{kg}\) such that \(\left[\text{part}\right](\text{kg}) = \lambda n. \lambda P. \lambda x. [\mu_{\text{kg}}(x) = n \land P(x)]\).

For our current purposes, we do not have to decide between these alternatives since both are compatible with the following semantics for the measure phrase \(\text{kaksi kilo-a}\) (‘two kilo-PART’):

\[
\left[\text{kaksi kilo-a}\right] = \lambda P. \lambda x. \left[\mu_{\text{kg}}(x) = 2 \land P(x)\right]
\]

With this interpretation of measure phrases, our account makes the right predictions, namely that singular count nouns in partitive case such as \(\text{omena-a}\) (‘apple-PART’) are not grammatical as arguments to measure phrases. If sense (39a) of PART is selected to apply to \([\text{omena}]\), then this leads to a type clash as shown in (41). However, if sense (39b) of PART is selected to apply to \([\text{omena}]\), then this returns the empty set, and so the denotation \(\text{kaksi kilo-a omena-a}\) (‘two kilo-PART apple-PART’) would also be empty thus this sense of PART would be ruled out on pragmatic (quality and quantity) based grounds.

\[
\left[\# \text{kaksi kilo-a omena-a}\right] = \left[\lambda P. \lambda x. \left[\text{kaksi kilo-a}\right](x) \land P(x)\right]\left([\text{omena}]\right)
\]

\[
\left[\text{kaksi kilo-a}\right] : \langle\langle e, t \rangle, \langle e, t \rangle\rangle, [\text{omena-a}] : \langle n, \langle e, t \rangle \rangle \iff \text{TYPE CLASH!}
\]

Plural count nouns and mass nouns, however, are felicitous in measure constructions:

\[
\left[\text{omeno-i-ta}\right] = \left[\text{PART}\right]\left([\text{PL}]\left([\text{omena}]\right)\right) = \lambda x. \exists y. \left[\text{*apple}\_y \land x \in \text{PartSet}(y, \text{*apple}) \land x \neq y\right]
\]

\[
\left[\text{kaksi kilo-a omeno-i-ta}\right] = \lambda x. \exists y. \left[\mu_{\text{kg}}(x) = 2 \land \text{*apple}_y \land x \in \text{PartSet}(y, \text{*apple}) \land x \neq y\right]
\]

In words, (43) is the set of apples or sums thereof that measure 2 kilos in weight (with the implication that these are not all of the apples).

In summary, we have argued that partitive morphology is polysemous in a way that effectively results in a sensitivity to whether the noun the partitive applies to denotes a quantized predicate

\[\lambda x. \exists y. \left[\text{*apple}_y \land x \in \text{PartSet}(y, \text{*apple}) \land x \neq y\right] \]

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\[\lambda x. \exists y. \left[\text{*apple}_y \land x \in \text{PartSet}(y, \text{*apple}) \land x \neq y\right] \]

In words, (43) is the set of apples or sums thereof that measure 2 kilos in weight (with the implication that these are not all of the apples).

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(e.g. is singular count on the one hand, or is plural count or mass on the other). This polysemy not only explains why counting constructions require singular count nouns, but also why measure phrases (such as *kaksi kilo-a*, ‘two kilo PART’) cannot combine with singular count nouns (in partitive case).

6. Extending the analysis to derive restrictions on partitive subjects

Based on the analysis of PART given in section 5.2, with only few extra assumptions about definite and indefinite DPs, we can also derive a restriction on partitive subjects in Finnish.

6.1. Partitive and Nominative subjects in Finnish

The subjects of some intransitive verbs in Finnish display case alternation (see Kiparsky 1998; Karlsson 2018; amongst others). Unsurprisingly, subjects can be in nominative case, but they can also be in partitive case. However, partitive subjects cannot be singular count nouns (44). Partitive subjects formed with mass nouns or plural count nouns are interpreted as indefinite (45). Nominative subjects are interpreted as definite for plural count nouns (46) and mass nouns (47) but as underspecified for definiteness for nominative singular count nouns (48).9

(44) #Omena-a on pöydä-llä.
   apple-PART be.3 table-ADESS
   ‘Apple is on the table.’

(45) Omeno-i-ta / Riisi-ä on pöydä-llä.
    apple-PL-PART / rice-PART be.3 table-ADESS
    ‘There are apples/There is rice on the table.’
    Not: The apples are / the rice is on the table.

(46) Omena-t ovat pöydä-llä.
    apple-PL be.3.PL table-ADESS
    ‘The apples are on the table’

(47) Riisi on pöydä-llä.
    rice be.3 table-ADESS
    ‘The rice is on the table’

(48) Omena on pöydä-llä.
    apple be.3 table-ADESS
    ‘An apple / the apple is on the table’

6.2. Extending the analysis to partitive and nominative subjects

To extend our analysis to the data in (44)-(48), we need a couple of extra assumptions. Our first additional assumption is that nominative case is semantically vacuous ([NOM] = \(\lambda P. P\)). Our second additional assumption is that, since (written) Finnish lacks articles, we have two

9For sentences such as (48), the indefinite reading can be made more salient if the subject is sentence final *Pöydällä on omena.*
type-shifting functions (i.e., the interpretations of a null D head):

\[
\text{INDEF} : \langle et, \langle \langle e, vt \rangle, vt \rangle \rangle = \lambda P : \langle et, e \rangle \implies \lambda E : \langle e, \langle v, t \rangle \rangle \implies \lambda e. \exists x. \mathcal{G}(x)(e) \land P(x)
\]

\[
\text{DEF} : \langle et, e \rangle = \lambda P : \langle et, e \rangle . \iota P
\]

\text{INDEF} introduces an indefinite GQ and so enables a subject NP to compose with a VP. The definition of \text{DEF} we use is based on that proposed by Chierchia (1998: p. 346):

\[
\begin{align*}
\text{a.} & \quad tX = \text{the largest member of } X \text{ if there is one (else, undefined)} \\
\text{b.} & \quad \text{the dogs } = tDOGS = \text{the largest plurality of dogs} \\
\text{c.} & \quad \text{the dog } = tDOG = \text{the only dog (if there is one)}
\end{align*}
\]

The last ingredient we need is a representation of an intransitive VP, which we assume to be of type \( \langle e, \langle v, t \rangle \rangle \). For the purposes of explication only, our working example will be based on the following representation of \text{on pöydä-llä} (is on the table), an intransitive VP containing a PP:

\[
\text{(52) } \quad [\text{on pöydä-llä} = \lambda x . \lambda e . [\text{location}(e, \text{on table}) \land \text{theme}(e, x)]}
\]

6.2.1. Intransitive VPs and singular count nouns as nominative subjects

In our analysis, singular and plural nouns in nominative case and partitive case marked mass nouns and plural count nouns are of type \( \langle e, t \rangle \). Given that intransitive VPs are of type \( \langle e, \langle v, t \rangle \rangle \), we must assume the presence of a null D that is realised as either DEF or INDEF. This leaves two possible derivations for the sentence in (48), one using DEF and the other using INDEF.

The derivation using DEF:

\[
\text{(53) } \quad \text{DEF(omena)} = \iota(\text{apple})
\]

I.e. the single apple that is in the context

\[
\text{(54) } \quad \text{(52)(DEF(omena)) } = \lambda e . [\text{location}(e, \text{on table}) \land \text{theme}(e, \iota(\text{apple}))]
\]

The set of eventualities in which the single apple in the context is on a/the table

The derivation using INDEF:

\[
\text{(55) } \quad \text{INDEF(omena)} = \lambda \mathcal{G} : \langle e, v, t \rangle . \lambda e . \exists x . \mathcal{G}(x)(e) \land \text{apple}(x)
\]

I.e., a function from verbal predicates to the set of eventualities in which there is an apple on a/the table.

\[
\text{(56) } \quad \text{(52)(INDEF(omena)) } = \lambda e . \exists x . [\text{location}(e, \text{on table}) \land \text{theme}(e, x) \land \text{apple}(x)]
\]

The set of eventualities in which there is an apple on the table.

In summary, singular count noun subjects in nominative case are entirely compatible with the application of DEF or INDEF, hence the different available readings in (48).
6.2.2. Intransitive VPs and partitive subjects

Singular count nouns in nominative case or mass or plural count nouns in partitive case, in our analysis, are of type \( \langle e, t \rangle \). In contrast, singular count nouns in partitive case are of type \( \langle n, et \rangle \). This straightforwardly accounts for the infelicity of partitive subjects for singular count nouns since singular count nouns in partitive case are the wrong type to compose with an intransitive VP. This explains the data in (44), repeated here as (57):

(57) #Omena-a on pöydä-llää.
apple-PART be.3 table-ADESS
‘Apple is on the table.’

PL count nouns in partitive case (and mass nouns in partitive case) are of the right type to be subjects. What remains to be explained is why they can only be interpreted as indefinite DPs, i.e., the pattern in (58):

(58) Omeno-i-ta on pöydä-llää.
apple-PL-PART be.3 table-ADESS
‘There are apples on the table.’
Not: The apples are on the table.

The explanation for this follows directly from the interaction between our proposed analysis for \( \text{PART} \) and the definition of \( \text{DEF} \). The relevant sense for \( \text{PART} \) is repeated is in (59), repeated from (39b). For a predicate \( P \), this is the set of \( P \)s (individual entities and sums thereof) excluding the supremum of \( P \).

(59) \[ \lambda P . \lambda x . \exists y . [ P(y) \land x \in \text{PartSet}(y, P) \land x \neq y ] \]

In contrast, the \( \text{DEF} \) shift entails that the supremum of \( P \) (locally in the context) is denoted. Therefore, for count nouns such as \( \text{omena} \) (‘apple’), \( \text{DEF}(\text{PART}(\text{PL})(\text{omena})) \) will be semantically anomalous since the meaning of the partitive morpheme and \( \text{DEF} \) are effectively at odds with one another.

Plural marked nouns in partitive case and mass nouns in partitive case, unlike singular marked nouns in partitive case, can be partitive subjects if we use \( \text{INDEF} \). For example, for \( \text{omeno-i-ta} \) (apple-PL-PART), we have:

(60) \( \text{PL}(\text{omena}) = \lambda x . \ast \text{apple}(x) \)
(61) \( \text{PART}((\text{60})) = \lambda x . \exists y [ \ast \text{apple}(x) \land \ast \text{apple}(y) \land x \sqsubseteq y ] \)
(62) \( \text{INDEF}((\text{61})) = \lambda e . \lambda x . \exists y [ \epsilon (x)(e) \land \ast \text{apple}(y) \land x \in \text{PartSet}(y, \ast \text{apple}) \land x \neq y ] \)

Which, when applied to (52) yields the set of eventualities in which there are apples on the table (but not all of the apples in the context), i.e., that there are some apples on the table. In other words, mass nouns and plural count nouns in partitive case have to have an indefinite interpretation whenever they are felicitously used in the subject position.
6.2.3. Intransitive VPs: count nouns as nominative plural subjects and mass nouns as nominative subjects

Finally, we need to explain why subjects are interpreted as definite if they are either plural count or mass and in nominative case (46)-(47). We suggest that the explanation for this is pragmatic, not semantic, and arises as the result of reasoning based on case alternatives. Given that the interpretation of singular nominative mass nouns such as \textit{riisi} and plural count nouns in nominative case such as \textit{omena-t} are of type $\langle e,t \rangle$, there is no semantic reason why they cannot be combined with INDEF or DEF. However, given that partitive mass and partitive plural count nouns are alternatives for the nominative forms, and given that, as we have shown, the partitive forms must be interpreted as indefinite, the definite interpretations of \textit{omena-t} (apple-PL) and \textit{riisi} (‘rice’) in (46)-(47) can be explained as an implicature. As evidence for this, we note that, where there is no partitive subject alternative available, mass and plural count subjects in nominative case can be interpreted as either definite or indefinite as the examples below from Karlsson (2018) show for the plural count noun subject \textit{poja-t} (boy-PL) and the mass noun subject \textit{kahvi} (coffee):

(63)  Poja-t potkivat pallo-a.
      boy-PL kick.3 ball-PART
     ‘(The) boys kick a/the ball’

(64)  Kahvi on hyvä-ä.
      coffee be.3 good-PART
     ‘(The) coffee is good’

7. Conclusions

We began with data on Finnish counting and measuring constructions which demonstrate that (i) count nouns in counting constructions are partitive singular but partitive plural in measure constructions and (ii) mass nouns are infelicitous in counting constructions but are partitive singular in measure constructions. We posited that to capture the data the partitive is derived from mereological parthood (the notion of \textit{PartSet}) and sensitive to quantization (mass/count). The analysis proposed here supports theories that argue that PL nouns in counting constructions are semantically plural.

Making the partitive sensitive to quantization also correctly predicts a key distributional fact about partitive subjects. Under our analysis, partitive singular count nouns are of type $\langle n,\langle e,t \rangle \rangle$ and partitive plural count nouns and partitive singular mass nouns are $\langle e,t \rangle$. On the assumption that indefinite NPs can be derived via $\exists$-closing type $e$ arguments of type $\langle e,t \rangle$ NPs and forming a GQ, this analysis predicts that partitive singular count nouns should not be allowed in subject position (they are of type $\langle n,\langle e,t \rangle \rangle$), but partitive plural count nouns and partitive singular mass nouns can be in subject position (since they are type $\langle e,t \rangle$).

Our proposed analysis is (to our knowledge) the first compositional analysis of the Finnish partitive morpheme that (i) accounts for counting and measuring constructions and (ii) also predicts a key distributional fact on partitive subjects. Our analysis accounts for this data with standard assumptions about the semantics of plural morphology while keeping parthood as the core meaning of the partitive morpheme.
As demonstrated above, count nouns are in the partitive singular in counting constructions. An interesting case for future investigation where a count noun is in the partitive plural in a counting construction is given in (65). In (65), the noun *kirjoja* ‘books’ is discontinuous from the numeral.

(65) Oman *hyllyn kirjo-j-a luin kaksi.*
    own.GEN shelf.GEN book-PL-PART read.PAST.1 two

‘Of the books on my shelf, I read two (of them).’ ‘I read two books on my shelf.’

Further investigation of the syntactic and semantic structure of (65) is needed to determine why the count noun is in the partitive plural. For instance, is (65) an instance of subextraction of the NP *oman hyllyn kirjoja* from the object position? Is this a partitive structure, different than the counting constructions presented above? We leave these questions open for future work.

References


[^10]: [http://riinankirjapinot.blogspot.com/2013/03/helmikuun-kirjat.html](http://riinankirjapinot.blogspot.com/2013/03/helmikuun-kirjat.html). Thanks to Gisbert Fanselow for making us aware of such data.
The Finnish partitive in counting and measuring constructions

The interaction of just with modified scalar predicates
William THOMAS — The Ohio State University
Ashwini DEO — The Ohio State University

Abstract. It remains an open question whether the range of uses associated with the English particle just can be analyzed uniformly. Much previous literature has focused on the exclusive uses of just with relatively little attention paid to its non-exclusive uses. We provide an analysis for the approximative use of just, which occurs with modified scalar predicates in sentences like Mary is just taller than John or Mary is just as tall as John. We argue that this use of just has two effects: (1) it conveys that its prejacent is true at a maximal level of precision, and (2) it conveys that its prejacent is not true at any lower level of precision that would make a stronger claim. On this analysis, the approximative use of just is similar to the exclusive use in that the effect in both cases is that stronger alternatives to the prejacent are ruled out.

Keywords: exclusives, approximators, precisification, degree semantics, gradability.

1. Introduction

Much of the previous research on just in the formal semantics literature (e.g. Horn, 2000; Grosz, 2012; Coppock and Beaver, 2014) has focused on its exclusive uses, such as those shown in (1).

(1) a. This is just/only for fun.
   ‘This is for fun and nothing else.’
   (Coppock and Beaver, 2014)

b. John is just/only a graduate student.
   ‘John is a graduate student and nothing more.’
   (Coppock and Beaver, 2014)

However, as has been pointed out in the descriptive literature (e.g. König, 1991: 121–124; Traugott, 1988: 129–132), just exhibits a much wider range of uses than other exclusives. For example, just has emphatic uses, which Beltrama (2018) has analyzed as involving reference to metalinguistic alternatives (2). Wiegand (2018) describes a class of uses that she labels as “unexplanatory” just, in which just conveys that the prejacent came about without a clear, known reason (3).

(2) Emphatic:
   The food was just amazing!
   (Beltrama, 2018)

(3) Unexplanatory:

1 We would like to thank Bob Levine, Mike White, and the OSU Syntax and Pragmatics discussion groups for helpful discussion of this work. We are also grateful for comments from audiences at the 3rd Crete Summer School for Linguistics and Sinn und Bedeutung 24, as well as anonymous abstract reviewers for SuB24.

2 A reviewer points out the use of just with reason modifiers, as in (i).

(i) Every time I thought about breaking up my heart just broke because of the kids.

This seems to us to be a kind of emphatic use of just. This sentence makes reference to the extreme upper portion of a scale, as breaking is among the worst things that could happen to the speaker’s heart. Just seems to have a strengthening effect similar to its effect in (2).

I was sitting there and the lamp just broke!
(Wiegand, 2018)

In this paper, we focus on the use of just with scalar predicates where it does not uniformly give rise to upper-bounding exclusive-like inferences. In these uses, just can be more accurately said to convey exactness or nearness. The examples shown in (4)–(5) illustrate the sort of inferences that are of interest here. All example sentences in this paper are taken from the Corpus of Contemporary American English (Davies, 2008) unless indicated otherwise.

(4) Miniature amaryllis are apt to be just as tall as hybrid amaryllis.
⇝ Miniature amaryllis are as tall as hybrid amaryllis at the highest level of precision.

(5) Fafen, the daughter just older than Siri, had done the family duty and become a monk.
⇝ Fafen is slightly older than Siri.

To borrow Sauerland and Stateva’s (2011) terminology for expressions that make vague assertions more or less precise, we will call this use of just “approximative”. We argue here that in its approximative use, just uniformly has two effects: (1) it conveys that its prejacent is true at a high level of precision, and (2) it conveys that its prejacent is not true at any lower level of precision that would make a stronger claim. Both these inferences are analyzed as being part of the assertoric or truth-conditional component of just, which leads to differences in interactions with contextual expectations from what is observed with a more standard exclusive like only. Although the analysis, as it stands, does not explicitly unify the exclusive and approximative uses of just, it does reveal a similarity between them, namely that both rule out stronger alternatives to the prejacent.

Section 2 summarizes key ideas in the literature on exclusives, focusing on analyses formulated within the Question Under Discussion framework (Roberts, 2012). In Section 3, we present data on the behavior of approximative just and describe the inferences that arise when it occurs in equative and comparative constructions. A formal analysis of the meaning of approximative just is presented in Section 4 before concluding in Section 5.

2. Background

2.1. Exclusives

At least since Beaver and Clark (2008), exclusives have been analyzed as placing an upper bound on the viable answers to a question salient in the context. What characterizes this approach is that potential answers to the salient question (labeled the Current Question or CQ) are ordered from weak to strong, either relative to an entailment scale (stronger propositions entail weaker propositions) or through some pragmatically based scale, such as a scale of importance or newsworthiness. The intuition with expressions such as only is that they contain a positive

3The CQ, even if not explicitly uttered, can be inferred from the placement of prosodic prominence in a declarative utterance. The idea is that prosodically prominent constituents bear the information-structural property of focus. The presence of focus evokes a set of alternatives that may be generated by replacing the prosodically prominent element with other expressions that denote objects of the same type (Rooth, 1985). A declarative assertion is taken to be congruent to the CQ if the set of focus alternatives is identical to the denotation of the CQ. It is because an assertion is presupposed to be congruent to the CQ, that listeners can infer the CQ from the placement of prosodic prominence (Roberts, 1996). Examples of inferences about the CQ (adapted from Beaver and Clark, 2008) are shown in (i).
and a negative component. On the one hand, they convey that the prejacent is the strongest true alternative answer to the CQ. On the other hand, they have a downtoning function, indicating that the prejacent is not the strongest answer that might be expected in the utterance context. Beaver and Clark (2008) model this intuition by integrating ideas from Rooth’s (1985, 1992) Alternative Semantics and the question based model of discourse developed in Roberts (1996).

On Beaver and Clark’s (2008) analysis, the discourse function of only is to comment that its prejacent is weaker than expected on a contextually salient scale. This contextual expectation is reflected in only’s presupposition that there is a true answer to the CQ among the alternatives that is at least as strong as the prejacent. Only’s truth-conditional component states that the prejacent is the strongest true answer to the CQ. An example is shown in (6).

(6)   CQ: Who did Mary invite to the party?
      a. Mary only invited [John and Mike].
         → Mary invited at least John and Mike. Presupposed content
         → Mary invited at most John and Mike. Asserted content

(Coppock and Beaver, 2014)

The complement-exclusion readings of only above can be obtained in the scalar framework by ranking alternative answers as a boolean lattice. In this case, the salient scale is an entailment scale, which means that a proposition \( p \) is at least as strong as a proposition \( q \) if and only if \( p \) entails \( q \). The “at most” inference in (6) rules out all alternatives stronger than the prejacent, which amounts to entailing that Mary did not invite anyone other than John and Mike. Assume, for example, that the only salient individuals are Mary, John, Mike, and Frank. The proposition \( \text{Mary invited John, Mike, and Frank} \) entails the proposition \( \text{Mary invited John and Mike} \). The former is therefore stronger than the latter, so (6a) entails that \( \text{Mary invited John, Mike, and Frank} \) is false. The boolean lattice in Figure 1 ranks propositions that are stronger answers above the answers they are stronger than and thus expresses the upper-bounding inference associated with the use of only. Answers that (6a) rules out are crossed out.

![Figure 1: Answers to the CQ ruled out by only (Coppock and Beaver, 2014)](image)

As Beaver and Clark argue, it is demonstrable that the “at least” inference is presuppositional by carrying out the standard tests for presupposition (embedding the sentence containing the trigger under entailment-canceling operators):

(i)   a. Sandy feeds [Fido]; Nutrapup.
      CQ: Who does Sandy feed Nutrapup?
      b. Sandy feeds Fido [Nutrapup].
      CQ: What does Sandy feed Fido?
The interaction of just with modified scalar predicates

(7) a. Mary didn’t only invite [John and Mike]$_F$. \(\leadsto\) Mary invited at least John and Mike.
b. Did Mary only invite [John and Mike]$_F$? \(\leadsto\) Mary invited at least John and Mike.
c. Mary may have only invited [John and Mike]$_F$. \(\leadsto\) Mary invited at least John and Mike.

To account for this and other data, Coppock and Beaver (2014), building on Beaver and Clark (2008), define two focus-sensitive operators MIN and MAX shown in (8) and (9). MIN corresponds to the “at least” inference: Given a prejacent proposition \(p\), \(\text{MIN}_S(p)\) is true in a world \(w\) if there is an answer \(p'\) to the CQ that is true in \(w\) and at least as strong as \(p\) on the scale \(\geq S\). MAX accounts for the upper-bounding “at most” inference: Given a prejacent proposition \(p\), \(\text{MAX}_S(p)\) is true in a world \(w\) if every true answer \(p'\) to the CQ is no stronger than \(p\).

\[
\text{MIN}_S(p) = \lambda w. \exists p' \in \text{CQ}_S[p'(w) \land p' \geq_S p] \\
\text{MAX}_S(p) = \lambda w. \forall p' \in \text{CQ}_S[p'(w) \rightarrow p \geq_S p']
\]

An exclusive particle like only can now be assigned the meaning in (10).\(^4\) According to (10), for any prejacent \(p\) and information state \(S\), a declarative utterance of the form only \(p\) presupposes that there is a true answer to the CQ \(S\) at least as strong as \(p\) and asserts that no true answer to the CQ \(S\) is stronger than \(p\).

\[
[\text{only}]^S = \lambda p. \lambda w : \text{MIN}_S(p)(w) . \text{MAX}_S(p)(w)
\]

2.2. Degree semantics

The interaction of the exclusive expression just with equative and comparative constructions in Section 3.1 and Section 3.2 relies on standard assumptions about the semantics of gradable adjectives and degree morphology. We adopt Kennedy’s (2001) treatment of degrees as intervals on a scale, where each positive degree is represented by a closed interval from zero to a point on the scale, while each negative degree is represented by an interval from a point on the scale to infinity. Gradable adjectives denote functions that take a degree and an individual and return true if the maximum degree to which the individual has the property associated with the adjective is the given degree. Measure phrases like 11 years or 5 feet denote functions that take a gradable adjective and an individual and return true if the individual has the property denoted by the adjective to a degree greater than or equal to a particular value (Kennedy and McNally, 2005). An example derivation of the meaning of five feet tall within this framework is shown in (11), where \(G\) is a gradable adjective, \(x\) is an individual, and \(d\) is a degree.

\[
[\text{tall}] = \lambda d \lambda x. [\text{tall}(x) = d] \\
[\text{five feet}] = \lambda G_{(d, e, t)} \lambda x. \exists d [d \geq \text{five-feet } \land G(d)(x)] \\
[\text{five feet tall}] = [\text{five feet}]( [\text{tall}] ) = \lambda x. \exists d [d \geq \text{five-feet } \land \text{tall}(d)(x)]
\]

Kennedy and McNally’s (2005) lexical entries for the English equative and comparative markers are in (12). Comparatives convey that one individual has a property to a greater or lesser degree than another individual, while equatives convey that one individual has a property to at least as high a degree as another individual.

\[
[\text{et/more than } d_c] = \lambda G \lambda x. \exists d [d > d_c \land G(d)(x)]
\]

\(^4\)The proposition between the colon and period corresponds to the presuppositional content associated with the expression, as in the notation of Heim and Kratzer (1998).
2.3. Imprecision and vagueness

Scalar expressions are often used imprecisely, which is to say that they are permissible in contexts in which they are false on their strictest interpretation. For example, in many contexts (13) is an appropriate description of Mary’s height even if Mary is slightly shorter than five feet, perhaps four feet eleven and a half inches. What counts as ‘five feet’ thus depends on the context, and tiny differences in height are often irrelevant for the purposes of ordinary conversation.

(13) Mary is five feet tall. (Constructed example)

Lasersohn (1999) argues that utterances used imprecisely are false yet “pragmatically permissible” because they are “‘close enough’ to the truth for practical purposes.” On this account, (13) is, strictly speaking, false if Mary is even one nanometer shorter than five feet. In fact, a sufficiently precise measuring instrument will find that no one is exactly five feet tall, so every utterance of (13) is false a priori. This view has met with objections (e.g. van Rooij, 2011; Solt, 2014) on the grounds that it takes a deeply counterintuitive position, rendering virtually any utterance involving numerals as false. For this reason, we will assume that permissible imprecise utterances are in fact true relative to coarse-grained scales.

Many authors (see e.g. van Rooij, 2011; Solt, 2014; Sauerland and Stateva, 2011; Lewis, 1979) have taken imprecision to be a kind of vagueness. Sauerland and Stateva (2011) argue that imprecision, which they term “scalar vagueness” needs to be distinguished from another kind of vagueness, “epistemic vagueness”. Intuitively, the difference between them is that the possible denotations of scalarly vague expressions (like five feet or 6 o’clock) seem to be clustered around some “core concept” (the exact length of five feet and the precise time 6 o’clock, respectively), whereas epistemically vague expressions (like tall or heap) do not seem to have such a core concept. This distinction is linguistically relevant because it has consequences for the distribution of approximators. For example, the approximators exactly, approximately, completely, and more or less reduce scalar vagueness, but they do not combine with epistemically vague expressions. Expressions like definitely and maybe, on the other hand, can be used to reduce epistemic vagueness. We show in the next section that approximative uses of just occur only with scalarly vague expressions.

How much deviation a scalarly vague expression tolerates depends on the level of precision relative to which it is interpreted. Following Krifka (2007), Sauerland and Stateva (2011) use

5The constructed sentences in (i) and (ii) provide examples of the two kinds of vagueness and some approximators that Sauerland and Stateva (2011) claim interact with them. The sentences in (i) exhibit scalar vagueness, while the sentences in (ii) exhibit epistemic vagueness. The expressions in bold are approximators.

(i) Scalar approximators
   a. Mary is exactly/precisely/approximately five feet tall.
   b. The glass is completely/more or less full.

(ii) Epistemic approximators
   a. John is definitely/certainly tall.
   b. John is tall-ish.
The notion of scale granularity to represent precision. Granularity is analogous to the markings on a ruler; if the markings are closer together, more precise measurements are possible. Thus if small measurements are relevant to a conversation, a fine scale granularity is used. If more imprecision is to be tolerated, a coarser scale granularity is used. Scalar approximators are one means that speakers can use to signal what granularity should be used to interpret an utterance. According to Sauerland and Stateva, fixing the scale granularity eliminates scalar vagueness, but it has no effect on epistemic vagueness. This is why scalar approximators do not combine with epistemically vague expressions.

Sauerland and Stateva (2011) formalize levels of precision by introducing granularity functions as contextual parameters of interpretation to which truth is relativized. We will also take this approach, but we defer the formal details to section 4.

3. Data

The approximative use of just occurs with a range of modified and unmodified scalar predicates. (They also occur with certain other expressions, but we will leave those aside for now. See Section 5 for examples.) In out of the blue contexts, just is typically focused on its approximative use. This helps to distinguish the approximative use from the exclusive one, in which some constituent in the syntactic scope of just receives prosodic prominence and is understood to be focused. In the examples that follow, we will use [...] to mark focus.

3.1. Equatives

When just combines with equative constructions, it can yield a reading that is not available to exclusives. This non-exclusive reading is brought out in the (a) sentences in (14) and (15). They become infelicitous if just is replaced by only, as shown in the (b) sentences.

(14)  a. More and more evidence shows that relatively simple changes in lifestyle can have a big impact on your blood pressure—in many cases, just as big as popping a pill.
      b. #... in many cases, only as big as popping a pill.

(15)  a. Many gardeners are finding the new selections of miniature amaryllis more to their liking. ... However, don’t be misled by the word “miniature.” The blossoms are smaller and have longer, more trumpet-shaped blooms than the flat, flared faces of hybrid bulbs, but the stalks are apt to be just as tall.
      b. #... but the stalks are apt to be only as tall.

(14b) and (15b) are infelicitous because the expectation-lowering function of only is incompatible with actual expectations in the discourse context. In (14), the assertion that “more and more evidence” shows that simple changes can have a big impact suggests that this impact is larger than expected (if it were expected, so much evidence would not be needed to demonstrate it). In (14b), however, the use of only conveys that the impact is weaker than what might be expected in context – leading to a contradiction. Similarly, in (15), the stalks of miniature amaryllis are expected to be shorter than those of hybrid amaryllis (given the term ‘miniature amaryllis’), but in fact the stalks of miniature amaryllis are as tall as those of hybrid amaryllis. What is expected is thus weaker than what the fact of the matter is but the use of only in (15b) conveys that the expectation in the context is stronger relative to the facts.
The felicity of (14a) and (15a) points to a clear contrast between the way in which the particles \textit{just} and \textit{only} interact with contextual expectations. Whereas \textit{only} obligatorily conveys that its prejacent is a weaker alternative than what is expected in the discourse context (leading to infelicity when contextual expectations are weak), \textit{just} can felicitously combine with a prejacent that is a stronger alternative than what is expected in the discourse context.

Another crucial difference between \textit{only} and \textit{just} in (14)–(15) is that \textit{only} enforces an upper bound on the scale associated with the predicate, but \textit{just} does not. (14b) entails that the impact of simple lifestyle changes is no greater than the impact of popping a pill. In contrast, we would not judge (14a) to be false if the impact of simple lifestyle changes is greater (possibly vastly so) than the impact of popping a pill. We would likewise not judge (15a) to be false if the stalks of miniature amaryllis are, in fact, even taller than those of hybrid amaryllis. These intuitions are consistent with the fact that (14a) and (15a) can be followed up with \textit{if not bigger} and \textit{if not taller}, respectively:

\begin{enumerate}
\item[(16)]
\begin{enumerate}
\item Changes in lifestyle can have a big impact on your blood pressure—\textit{just} as big as popping a pill, if not bigger.
\item The stalks of miniature amaryllis are apt to be \textit{just} as tall as those of hybrid amaryllis, if not taller.
\end{enumerate}
\end{enumerate}

As expected, the approximative reading of \textit{just} is disambiguable from the exclusive reading by the placement of prosodic prominence. Exclusive readings typically result when an element within the syntactic scope of \textit{just} is focused, as shown in (17). When used as an exclusive, \textit{just} is typically interchangeable with \textit{only}. The approximative reading is available when \textit{just} itself is in focus, as shown in (18).

\begin{enumerate}
\item[(17)]
\begin{enumerate}
\item Exclusive use of \textit{just}: Upper bound enforced
\begin{enumerate}
\item Changes in lifestyle can have \textit{just/only} \textit{as} big an impact as popping a pill (# if not bigger).
\rightarrow Changes in lifestyle can have at least as big an impact as popping a pill.
\rightarrow Changes in lifestyle can have at most as big an impact as popping a pill.
\item Miniature amaryllis are apt to be \textit{just/only} \textit{as} tall as hybrid amaryllis (# if not taller).
\rightarrow Miniature amaryllis are apt to be at least as tall as hybrid amaryllis.
\rightarrow Miniature amaryllis are apt to be at most as tall as those of hybrid amaryllis.
\end{enumerate}
\end{enumerate}
\end{enumerate}

\begin{enumerate}
\item[(18)]
\begin{enumerate}
\item Approximative use of \textit{just}: No upper bound enforced
\begin{enumerate}
\item Changes in lifestyle can have \textit{just} \textit{as} big an impact as popping a pill (if not bigger).
\rightarrow Changes in lifestyle can have at least as big an impact as popping a pill.
\rightarrow Changes in lifestyle can have at most as big an impact as popping a pill.
\item The stalks of miniature amaryllis are apt to be \textit{just} \textit{as} tall as those of hybrid amaryllis (if not taller).
\rightarrow Miniature amaryllis are apt to be at least as tall as hybrid amaryllis.
\rightarrow Miniature amaryllis are apt to be at most as tall as those of hybrid amaryllis.
\end{enumerate}
\end{enumerate}
\end{enumerate}

Instead of enforcing an upper bound, \textit{just} in (14a), (15a), and (18a) appears to \textit{raise} the lower bound conventionally established by the equative construction. We suggest that this effect
comes about because the use of *just* serves to increase the standard of precision in the discourse context. For example, uttering *Miniature amaryllis are as tall as hybrid amaryllis* might be permissible in a context where miniature amaryllis are actually slightly shorter than hybrid amaryllis, as long as the difference in heights is small enough to ignore for the purposes of the discourse. The use of *just* in this case conveys that even on a maximally fine-grained scale, miniature amaryllis are at least as tall as hybrid amaryllis – thus maximally reducing the difference in height that may be ignored.

To see that equative constructions do in fact tolerate imprecise uses, consider (19). After the speaker asserts that miniature amaryllis are as tall as hybrid amaryllis in (19a), they can increase the standard of precision in (19b) and assert that miniature amaryllis are not as tall as hybrid amaryllis at that new standard. The utterances do not contradict each other because they are interpreted with respect to different scale granularities.

(19)  
\begin{align*}  
a. & \text{Miniature amaryllis are as tall as hybrid amaryllis.} \\
   b. & \text{More precisely, miniature amaryllis are on average half a centimeter shorter than hybrid amaryllis.} 
\end{align*}

In contrast, if the speaker asserts that miniature amaryllis are *just* as tall as hybrid amaryllis, then further precisification is problematic. The utterance in (20a) is already interpreted at the highest permissible level of precision, so the speaker seems to be contradicting their previous utterance by uttering (20b).

(20)  
\begin{align*}  
a. & \text{Miniature amaryllis are *just* as tall as hybrid amaryllis.} \\
   b. & \#\text{More precisely, miniature amaryllis are on average half a centimeter shorter than hybrid amaryllis.} 
\end{align*}

3.2. Comparatives

*Just* is also used as an approximator in comparative constructions. In this case, *just* is roughly paraphrasable with *slightly*. Examples are given in (21), (22), and (23). In (21), Fafen is slightly older than Siri. In (22), the camera is slightly bigger than a card deck. In (23), Samantha is slightly over 5 feet tall.

(21)  
Fafen, the daughter [*just*$_F$ older than Siri, had done the family duty and become a monk.]

(22)  
The camera was a plastic but weighty box [*just*$_F$ bigger than a card deck.]

(23)  
At 11, Samantha is [*just*$_F$ over 5 feet tall and has wavy black hair.]

In contrast to its behavior with equatives, *just* does enforce a truth-conditional upper bound on the relevant scale when it combines with comparatives. The non-cancellability of the upper bounds in (21)–(23) is evidenced by the oddness of the utterances in (24).

(24)  
\begin{align*}  
a. & \#\text{Fafen is *just* older than Siri, if not much older.} \\
   b. & \#\text{The camera was *just* bigger than a card deck, if not much bigger.} \\
   c. & \#\text{Samantha is *just* over 5 feet tall, if not way over.} 
\end{align*}

By contrast, placing focus on *Siri, a card deck, or 5 feet tall* yields exclusive readings which are also available to *only*. On these readings, (25) says that Fafen is older than Siri but no taller
salient person, (26) says that the camera was bigger than a card deck but no other salient thing, and (27) conveys that Samantha’s height is not over any contextually salient height greater than five feet.

(25)  Fafen, the daughter just/only older than [Siri]\textsubscript{F}, had done the family duty and become a monk.

(26)  The camera was a plastic but weighty box just/only bigger than [a card deck]\textsubscript{F}.

(27)  At 11, Samantha is just/only over [5 feet tall]\textsubscript{F} and has wavy black hair.

Both (21)–(23) and (25)–(27) place an upper bound on the relevant property. However, while just interacts directly with the scales lexicalized by the adjectives in (21)–(23), only interacts with an entailment scale generated by varying the focused constituent in the sentence. Furthermore, the approximative use of just in (21)–(23) differs from the exclusive use in that it does not comment on the strength of its prejacent relative to a contextually salient expectation. (25), for example, conveys that Fafen was expected to be older than someone other than Siri, but (21) does not convey any such expectation.

In both the equative constructions in (18) and the comparative constructions in (21)–(23), the prejacent is true at a high level of precision. (18a) conveys that changes in lifestyle have as big an impact as popping a pill when the impact is measured on a very fine-grained scale, and (18b) conveys that miniature amaryllis are as tall as hybrid amaryllis when their heights are measured on a very fine-grained scale. Similarly, a fine-grained scale is able to detect the small differences in age, weight, and height conveyed by (21)–(23).

However, just cannot be effecting precisification when it occurs in comparative constructions because, as has been pointed out by Sauerland and Stateva (2011: f.n. 2) and Solt (2014), comparatives cannot be used loosely. For example, Solt (2014) observes that round numerical expressions must be interpreted precisely when they are embedded in comparative statements. But we note that even in the absence of numerical expressions, statements of comparison cannot involve a loose interpretation of the standard of comparison. This is illustrated in (28): (28b) is infelicitous as a follow-up to (28a) because (28a) is incompatible with Fafen being younger than Siri by any amount.

(28)  a. Fafen is older than Siri.
       b. #More precisely, she’s one day younger than Siri.

Further evidence that comparatives are never interpreted loosely is the fact that roughly speaking cannot be used to introduce a comparative: Although (29a) is acceptable, (29b) is not.

(29)  a. Strictly speaking, Fafen is older than Siri.
       b. #Roughly speaking, Fafen is older than Siri.

It is unsurprising that comparatives have this property because if they could be used loosely, then their meaning would be indistinguishable from the meaning of equatives. For example, if Fafen is older than Siri were permissible both in contexts where Fafen is slightly younger than or as old as Siri and contexts where Fafen is older than Siri, then it would have the same meaning as Fafen is as old as Siri, which is also permissible in precisely those contexts.

This raises the question of what it means to interpret a comparative at different levels of pre-
cision. According to Solt (2014), comparatives are completely insensitive to granularity level. She claims, for example, that the sentence The rope is fifty meters long is true at any granularity level if the rope is longer than fifty meters by any amount. However, this assumption predicts that if Fafen is only very slightly older than Siri, then at a coarse granularity level the contradictory propositions in (30) can be true simultaneously. This is undesirable because there is surely no context in which one could assert both (30a) and (30b) at the same level of precision.

(30) a. Fafen is older than Siri.
   b. Siri is as old as Fafen.

To avoid this contradiction, we assume that if the difference between Fafen and Siri’s ages is less than the grain size of the scale granularity, then (30a) is false. This is a reasonable assumption because the scale granularity is meant to represent the smallest relevant measurement at a level of precision. If the difference in their heights is small enough to be irrelevant, (30a) should be false at that level of precision.

It follows, crucially, that comparative statements make stronger claims whenever they are interpreted at lower levels of precision: If a coarse-grained scale can detect that Fafen is older than Siri, then any finer-grained scale can, too. Examples (21)–(23) seem to convey that their prejacent are true at a high level of precision, but not at any lower level of precision. This amounts to ruling out alternatives that are stronger than the prejacent on an entailment scale, which is quite similar to the function of the MAX component of exclusive just.

For the equatives in Section 3.1, this entailment relationship was reversed: If two entities count as equal according to a fine-grained scale, they will also count as equal according to a coarser-grained scale. That is, if a fine-grained scale can detect that Fafen and Siri are equivalent with respect to age, then any coarser-grained scale can, too. So equative statements will make stronger claims at higher levels of precision. In conveying that their prejacent are true at the highest level of precision, (14a) and (15a) also convey that their prejacent are true at every lower level of precision.

3.3. Status of the inferences

To summarize, just has two effects when it combines with modified scalar predicates in its approximative use: (1) It conveys that its prejacent is true at a high level of precision, and (2) it conveys that its prejacent is false at any lower level of precision that would make a stronger claim. We will refer to effect (1) as the positive meaning component and effect (2) as the negative meaning component. With comparative constructions, the use of just leads to the inference that the prejacent is true only at a high level of precision and not at lower levels of precision. With equative constructions, the higher the level of precision at which the prejacent is interpreted the stronger the claim, so effect (2) is uninformative and just conveys that the prejacent is true at a high level of precision (as well as at any lower level).

The question now is, what is the status of the positive and negative meaning components associated with just? We propose that it is reasonable to consider both to be part of the at-issue, asserted meaning of just. However, it is possible that either or both components are part of

\[^6\text{We already showed in (24) that the negative component is not cancellable, which suggests that it is not a conversational implicature.}\]
what is presupposed by just. If the positive component is presupposed, just would be similar to only, following the treatment in Beaver and Clark (2008) and Velleman et al. (2013). If the negative component were presupposed, just would be similar to cleft constructions. Velleman et al. (2013) propose that the cleft operator, in contrast to exclusive only, presupposes, rather than asserts, that there is no stronger true answer among the alternatives than the prejacent. The survival of an implication when the prejacent is embedded under negation is the best known test for its presuppositional status. The data in (31) and (32) provide evidence that both the positive and the negative component are part of the at-issue content of the base sentence and thus targeted by negation. Embedding a sentence containing approximative just under negation implies that the prejacent fails to hold at a high level of precision or that it is not false at all lower levels of precision that effect a stronger claim – that is, the prejacent is true at some lower level of precision.

(31) Embedding under negation (comparative)
   a. It is not the case that Fafen is just older than Siri →
   b. “Fafen is older than Siri” is not true at a high level of precision. OR
      “Fafen is older than Siri” is not false at every lower level of precision that would
      make a stronger claim (in other words, she is significantly older than Siri).

(32) Embedding under negation (equative)
   a. It is not the case that Fafen is just as old as Siri →
   b. “Fafen is as old as Siri” is not true at a high level of precision. OR
      “Fafen is as old as Siri” is not false at every lower level of precision that would
      make a stronger claim (in other words, she is significantly younger than Siri).

Further, Beaver and Clark (2008: 275–276) use the fact that reason clauses and emotive factive clauses can only target at-issue content to argue that the positive component of an exclusive is presupposed, while the negative component is asserted. These same tests can be applied to the approximative use of just. For instance, consider the constructed examples in (33) in a context where a water park requires that water slide riders be at least 5 feet tall, and the legal driving age is 16. In (33a), because targets the positive component: Samantha is allowed to ride the water slide because she is over five feet tall. In (33b), because targets the negative component: Samantha is prohibited from driving not because she is over eleven, but rather because her age is close to eleven, and therefore she is too young.

(33) a. Samantha is allowed to ride the water slide because she is just over five feet tall.
   → Samantha is allowed to ride the water slide because she is over five feet tall.
   (positive component targeted)
   b. Samantha is prohibited from driving because she is just over eleven years old.
   → Samantha is prohibited from driving because her age is close to eleven. (negative component targeted)

Likewise, the emotive factive clauses in (34) can target either component: (34) can convey either that the speaker was surprised that the camera was bigger than a card deck, or that the speaker was surprised that the camera was close to the size of a card deck.

(34) I was surprised that the camera was just bigger than a card deck.
   → I was surprised that the camera was bigger than a card deck.
I was surprised that the camera was only slightly bigger than a card deck.

Another piece of evidence that both meaning components are asserted is that an interlocutor can contradict either component, as shown in (35). Both (35a) and (35b) are quite natural and do not require backtracking. This suggests that both components are at-issue.

(35) Fafen is just taller than Siri.
   a. No she’s not, she’s shorter than Siri.
   b. No she’s not, she’s much taller than Siri.

Taken together, the data in (31)–(35) provide strong evidence that both meaning components are at-issue rather than presupposed. This is one way in which the approximative use of just differs from the exclusive use, which presupposes that an alternative at least as strong as the prejacent is true.

3.4. How just interacts with expectations

According to Beaver and Clark (2008), the discourse function of exclusives is to lower a contextually salient expectation. For example, (36a) yields an inference that Mary was expected to invite more people than John and Mike.

(36) CQ: Who did Mary invite to the party?
   a. Mary only invited [John and Mike].
      \[\therefore\] Mary was expected to invite other people besides John and Mike.

This expectation is related to the MIN presupposition that at least the prejacent is true. We have argued in 3.3 that the approximative use of just does not carry any such presupposition. In light of that, this use would not be expected to yield any inference about contextual expectations. This does indeed appear to be true for the comparative examples presented in section 3.2, such as the one reproduced in (37).

(37) a. Fafen is just older than Siri.
    \[\therefore\] Fafen is expected to be much older than Siri.
    \[\therefore\] Fafen is expected to be younger than Siri.

The case in which the approximative use of just does appear to license an inference about expectations is the equative case. The equative construction in (38), for example, suggests that miniature amaryllis are expected to be shorter than hybrid amaryllis, and this is indeed the expectation set up by the context given in (15a). Note that rather than lowering an expectation as exclusive only does, the effect of just in (38) is to raise an expectation.

(38) Miniature amaryllis are just as tall as hybrid amaryllis.
    \[\therefore\] Miniature amaryllis are expected to be shorter than hybrid amaryllis.

This interaction with expectations make sentences like (38) most natural as answers to biased polar questions. In (15a), for example, the CQ that the final clause answers would be like the one in (39), which is most appropriate if the asker doubts that miniature amaryllis are as tall as hybrid amaryllis (given that they are miniature versions of the original).

(39) CQ: Are miniature amaryllis really as tall as hybrid amaryllis?
A: Yes, miniature amaryllis are \([\text{just}]_F\) as tall as hybrid amaryllis.

Equate constructions with \(\text{just}\) make good answers to biased questions because of \(\text{just}'\)s precisifying effect. If the asker doubts that miniature amaryllis are as tall as hybrid amaryllis, then they will consider their bias confirmed if miniature amaryllis count as shorter than hybrid amaryllis at any level of precision (i.e. if they are shorter by any amount). In order to overcome the addressee’s bias, then, the speaker asserts that miniature amaryllis are at least as tall as hybrid amaryllis at a high level of precision. Space constraints prevent us from demonstrating that this interaction with contextual expectations is not derived from the conventionalized meaning of \(\text{just}\) and we leave this for further exploration.

4. Analysis

In order to provide a meaning for \(\text{just}\) that captures its sensitivity to levels of precision, it is necessary to formalize the notion of precision. One path would be to use Lasersohn’s (1999) notion of pragmatic halos.\(^7\) One might then attempt to explain the behavior of \(\text{just}\) in terms of pragmatic halos. Sentences like \(\text{Fafen is just older than Siri}\), in which \(\text{just}\) conveys that the prejacent is true at a high level of precision, could be accounted for if we take \(\text{just}\) to be a precisifier that contracts the pragmatic halo. The problem is that, as we showed in Section 3, these constructions, although they do depend on an appropriate level of precision for their interpretation, can never be used loosely.

A more fruitful approach is to conceive of levels of precision as scale granularities. A granular scale is divided into intervals whose width is a fixed grain size, and the points within each interval are not distinguishable from one another. A fine scale granularity results in precise measurements because points that are very close together can be distinguished from one another, while a coarse scale granularity results in less precise measurements. For example, on a distance scale with a grain size of one foot, all the distances from half a foot to one and a half feet are indistinguishable, so they are all referred to as “one foot”. We will assume that the scale granularity with respect to which an utterance is interpreted represents the smallest measurement that is relevant for the purposes of the discourse at the moment of utterance.

Sauerland and Stateva (2011) propose that truth is evaluated relative to scale granularity. For example, at a granularity with a grain size of one foot, the utterance \(\text{Mary is 5 five feet tall}\) is true (not just pragmatically permissible) in every world where Mary’s height is between 4’6” and 5’6”. On the other hand, if the grain size is two inches, then \(\text{Mary is 5 feet tall}\) is true only in those worlds where Mary’s height is between 4’11” and 5’1”. The idea is that the utterance context makes available a set of scale granularities (Sauerland and Stateva, 2011; Power and Williams, 2012), and an utterance is interpreted using a granularity level chosen from that set. For example, rounder numerals are interpreted less precisely (Krifka, 2007), and the choice of granularity can also be influenced by approximators (Sauerland and Stateva, 2011), degree

\(^7\)According to Lasersohn, an expression’s pragmatic halo is a set consisting of objects that differ from the expression’s denotation only in ways that are “pragmatically ignorable in context”, including the denotation itself. The pragmatic halo of a sentence is built up compositionally from the halos of its parts, and a sentence is assertable in a context if some proposition in its pragmatic halo is true. For example, the sentence \(\text{Mary is five feet tall}\) would be assertable in a context where Mary is four feet eleven inches tall just in case the proposition denoted by \(\text{Mary is four feet eleven inches tall}\) is a member of the pragmatic halo of \(\text{Mary is five feet tall}\). On this account, the effect of approximators is to shrink or expand the pragmatic halo. Thus \(\text{Mary is exactly five feet tall}\) has a smaller pragmatic halo than \(\text{Mary is five feet tall}\), and \(\text{Mary is approximately five feet tall}\) has a larger one.
 modifiers (Sassoon and Zevakhina, 2012), and approximating number pairs (Solt, 2015).

Sauerland and Stateva (2011) formalize granularity by introducing granularity functions, which partition a scale \( S \) into equally-sized intervals by mapping each point on the scale to an interval that contains it. So at a coarse scale granularity, a granularity function might map 5 meters to the interval \([4.5 \text{ m}, 5.5 \text{ m}]\). They postulate that a granularity function \( \gamma \) for a scale \( S \) has the properties in (40). (40a) says that \( \gamma \) maps every point on \( S \) to a set that contains it, (40b) ensures that all of these sets are intervals, and (40c) ensures they all have the same size. The operators \( \max \) and \( \min \) return the maximum and minimum points of an interval respectively.

\[
\begin{align*}
(40) & \quad \forall s \in S : s \in \gamma(s) \\
& \quad \forall s \in S : \gamma(s) \text{ is an interval}^8 \\
& \quad \forall s, s' \in S : \max(\gamma(s)) - \min(\gamma(s)) = \max(\gamma(s')) - \min(\gamma(s')) \\
\end{align*}
\]

(Sauerland and Stateva, 2011)

Sauerland and Stateva also provide the following definition: A granularity function \( \gamma \) is finer than \( \gamma' \) if:

\[
\forall s \in S : \max(\gamma(s)) - \min(\gamma(s)) < \max(\gamma'(s)) - \min(\gamma'(s))
\]

Gyarmathy (2017) prefers to use suprema rather than endpoints in statements like (40c) and (41) in order to remain agnostic about which endpoints are contained by the intervals in the range of granularity functions. We will follow this suggestion and use inf and sup rather than \( \min \) and \( \max \).

We assume that any expression that denotes a non-endpoint degree on its strictest reading always refers to an interval whose midpoint is that degree. In other words, given a linguistic expression \( D \) denoting a non-endpoint degree \( d \) (such as five feet or 12 years) and a context \( C \) such that the smallest relevant interval size is \( \epsilon \), there is a granularity function \( g \) such that the interpretation of \( D \) in \( C \) is given by (42).

\[
\begin{align*}
(42) & \quad [D] = \gamma(d) = (d - \epsilon, d + \epsilon) \\
\end{align*}
\]

Therefore, for convenience we will define the granularity level \( g \) as the function given in (43), where \( d \) is any degree on the scale, \( \epsilon \) is the smallest relevant interval size, and \( \min(S) \) and \( \max(S) \) are the minimum and maximum degrees on the scale (if they exist). The properties in (40) hold for granularity levels, but granularity levels, unlike granularity functions, do not define a partition on the scale.

---

8Sauerland and Stateva (2011) actually posit that \( \gamma(s) \) is convex, rather than requiring it to be an interval. They restrict themselves to considering closed scales because open scales may have logarithmic granularity (Hobbs and Kreinovich, 2006). A subset of a closed scale is convex if and only if it is an interval, so their requirement that \( \gamma(s) \) is convex for all \( s \) implies that \( \gamma(s) \) is an interval for their purposes. We assume here that \( \gamma(s) \) has the interval property for all \( s \) in order to ensure that \( \gamma(s) \) is also an interval when \( S \) is open. For the purposes of this paper, we will set aside the issue of whether open scales have logarithmic granularity.

9Note that this definition of granularity levels is different from the one given by Gyarmathy (2017). She defines a granularity level as the set of all granularity functions with a given grain size. If \( \Gamma \) is one of Gyarmathy’s granularity levels with grain size \( \epsilon \), then the granularity level \( g \) that we define in (43) is given by \( g(d) = \{d' : \exists \gamma \in \Gamma[d' \in \gamma(d)]\} \).

---
We propose (44) as the meaning of just in its approximative uses. In (44), \( g_{\text{finest}} \) is the finest granularity level with respect to which the prejacent can be interpreted in the utterance context (though not necessarily the finest granularity available in the context), \( G \) is the set of granularity levels no finer than \( g_{\text{finest}} \), \( p^g(w) \) means that the proposition \( p \) is true with respect to \( g \) in world \( w \), and \( \geq_S \) is an entailment strength ranking. The first conjunct says that the prejacent is true relative to \( g_{\text{finest}} \), and the second conjunct says that the prejacent is not true at any coarser granularity level that would make a stronger claim.

\[
(44) \quad \text{[just]} = \lambda w \lambda p. \forall g \in G \left[ p^g(w) \rightarrow p^{g_{\text{finest}}(w)} \right]^{10}
\]

\( g_{\text{finest}} \) is one of the available granularity levels under consideration in the context, but not necessarily the finest one. Rather, it is the finest granularity level with respect to which the prejacent in particular can be interpreted in the utterance context. The value of \( g_{\text{finest}} \) is affected by a variety of pragmatic factors, and it is dependent on both the lexical content of the prejacent and properties of the context.

At least three contextual factors are relevant for the determination of \( g_{\text{finest}} \), and future work may identify others. One factor is the magnitude of the measured quantities. Larger quantities tend to make coarser granularity levels available and make finer granularity levels irrelevant. For example, Fafen is just older than Siri has a slightly different meaning depending on how old Fafen and Siri are. If they are adults, it likely conveys that their ages are within a year or two of each other. If they are babies, it probably conveys that their ages are within weeks or months of each other. Another factor that bears on the value of \( g_{\text{finest}} \) is the amount of measurement error permitted in the context. Utterances in contexts that require greater precision have finer values of \( g_{\text{finest}} \). For instance, the utterance The rod is just over one foot long may have a more precise interpretation in a context where the rod is going to be used for a science experiment than in one where the rod is going to be used for a more everyday purpose. Finally, the value of \( g_{\text{finest}} \) is also affected by the roundness of numerals in the prejacent. The roundness of a numeral depends on the scale system conventionally applied to the subject matter (Krifka, 2007). Hence six inches is a fairly round length in the US measurement system, while 30 minutes is a fairly round amount of time. Krifka observes that rounder numerals are typically interpreted more loosely. The expression 30 minutes, for example, evokes a granular scale with 30-minute increments, so it denotes roughly the interval from 15 minutes to 45 minutes. By contrast, 45 minutes evokes a scale with 15-minute increments, so it denotes roughly the interval from 37.5 minutes to 52.5 minutes. Likewise, round numerals in the prejacent of just tend to result in coarser values of \( g_{\text{finest}} \). Thus just over 31 minutes conveys greater proximity to 31 minutes than just over 30 minutes does to 30 minutes.

4.1. Equatives

To account for how equative constructions are relativized to granularity level, we adopt with slight modification Kennedy and McNally’s (2005) meaning for equative morphology. This

\[\text{For just’s approximative use, } \geq_S \text{ is an entailment scale, so } p^{g_{\text{finest}}} \geq_S p^g \text{ is equivalent to } \forall w [p^{g_{\text{finest}}(w)} \rightarrow p^g(w)].\]
meaning is similar to the equative meaning given in (12c), but the degree \(d_c\) is replaced by the infimum of the interval \(g(d_c)\). The derivation of the meaning of \textit{Miniature amaryllis are as tall as hybrid amaryllis} is shown in (46), where \(d_{HA}\) is the degree of height of hybrid amaryllis. “MA” and “HA” abbreviate “miniature amaryllis” and “hybrid amaryllis”, respectively.

\[
\text{as } \ldots \text{ as } d_c] = \lambda G \lambda x. \exists d [d > \inf(g(d_c)) \wedge G(d)(x)]
\]

(46) a. \([\text{as tall as HA}] = \lambda x. \exists d [d > \inf(g(d_{HA})) \wedge \text{tall}(d)(x)]
\]

b. \([\text{MA are as tall as HA}] = \exists d [d > \inf(g(d_{HA})) \wedge \text{tall}(d)(MA)]
\]

The meaning in (45) accounts for the fact that equative constructions make stronger claims at higher levels of precision. To see why, consider the interpretations of (46a) with respect to two granularity levels \(g_1\) and \(g_2\) with grain sizes \(\varepsilon_1\) and \(\varepsilon_2\), respectively. These interpretations are shown in (47). The proposition in (47a) entails (47b) just in case \(d_{HA} - \varepsilon_1 \geq d_{HA} - \varepsilon_2\), which is true if and only if \(\varepsilon_1 \leq \varepsilon_2\). Thus (46b) is stronger at finer granularity levels.

\[
\exists d [d > (\text{MA}) \wedge \text{tall}(d)(MA)]
\]

Therefore, of all the granularity levels in \(G\), \(g_{\text{finest}}\) makes the strongest claim. As a result, when \textit{just} applies to (47b), the second conjunct of (44) is vacuously satisfied. The first conjunct of (44) therefore gives the entire meaning of \textit{Miniature amaryllis are as tall as hybrid amaryllis}. This is shown in (48), which says that miniature amaryllis are as tall as hybrid amaryllis at the finest permissible granularity level.

\[
\exists d [d > (\text{MA}) \wedge \text{tall}(d)(MA)]
\]

4.2. Comparatives

We propose that the comparative morphology has the meaning in (49), which again is based on the one given by Kennedy and McNally (2005). In contrast to the meaning of the equative morphology, this time the degree \(d_c\) is replaced by the supremum of \(g(d_c)\) rather than the infimum. The derivation of the meaning of \textit{Fafen is older than Siri} is shown in (50), where \(d_s\) is the degree of age of Siri.

\[
\text{er/more than } d_c] = \lambda G \lambda x. \exists d [d > \sup(g(d_c)) \wedge G(d)(x)]
\]

(50) a. \([\text{older than Siri}] = \lambda x. \exists d [d > \sup(g(d_s)) \wedge \text{old}(d)(x)]
\]

b. \([\text{Fafen is older than Siri}] = \exists d [d > \sup(g(d_s)) \wedge \text{old}(d)(f)]
\]

(49) correctly predicts that comparative constructions make stronger claims at lower levels of precision. To see why, consider below the interpretations of (50a) with respect to the two granularity levels \(g_1\) and \(g_2\). The proposition in (51b) entails (51a) just in case \(d_s + \varepsilon_1 \geq d_s + \varepsilon_2\), which is true if and only if \(\varepsilon_1 \geq \varepsilon_2\). Thus (50b) is stronger at coarser granularity levels.

\[
\exists d [d > (d_s + \varepsilon_1) \wedge \text{tall}(d)(f)]
\]

\[
\exists d [d > (d_s + \varepsilon_2) \wedge \text{tall}(d)(f)]
\]

\footnote{We use strict inequality rather than \(\geq\) because only intervals with size strictly less than \(\varepsilon\) are irrelevant.
Therefore, in the case of the comparative, $g_{\text{finest}}$ makes the weakest claim of all the granularity levels in $G$. As a result, when just applies to (51b), the second conjunct of (44) says that Fafen is older than Siri is false at every granularity level in $G$ except for $g_{\text{finest}}$. The sentence Fafen is just older than Siri, therefore, is predicted to mean that Fafen is older than Siri with respect to $g_{\text{finest}}$, but not with respect to any coarser granularity level. This means that Fafen’s age is $d_a + \epsilon_{\text{finest}}$, as desired.

5. Conclusion

We have argued for a uniform analysis of the approximative use of just when it occurs with comparative and equative constructions. Intuitively, this use of just has two effects: (1) It conveys that its prejacent is true at a high level of precision, and (2) it conveys that its prejacent is false at any lower level of precision that would make a stronger claim. We have implemented this in terms of scale granularity, showing that (1) amounts to conveying that the prejacent is true relative to the finest granularity level with which it can be interpreted in the utterance context, and (2) amounts to conveying that the prejacent is not true relative to any coarser granularity level that would make a stronger claim. Comparative constructions make stronger claims at coarser granularity levels, while equatives make stronger claims at finer granularity levels. For the latter, effect (2) is uninformative, while for the former, effect (2) enforces an upper bound on the scale. Analyzing just in terms of scale granularity correctly predicts that approximative uses of just only occur with expressions whose denotations depend on a granularity parameter. Although this analysis does not unify the approximative and exclusive uses of just, it does reveal a connection between them: Effect (2), which corresponds to the second conjunct of (44), is similar to Beaver and Clark’s (2008) $\text{MAX}$ operator in that it rules out stronger alternatives to the prejacent. A difference between them is that $\text{MAX}$ rules out focus alternatives, while the alternatives that approximative just considers are distinguished by the granularity level with respect to which they are interpreted. Another difference between these two uses is the status of the positive meaning component. Whereas exclusives presuppose $\text{MIN}$, we have shown that the first conjunct of (44) is asserted. Accordingly, approximative just does not exhibit the expectation-lowering effect that Beaver and Clark (2008) argue is the discourse function of exclusives.

The approximative use of just occurs with a range of constructions besides the equative and comparative constructions analyzed here. Our analysis should be extendable to account for all approximative occurrences of just. For example, just can combine with enough (e.g., just wide enough for one person), certain gradable adjectives (e.g., just visible in the distance), and spatial-temporal prepositions (e.g., just past the farmhouse) to yield a reading similar to barely, just as it does in comparative constructions. It can also combine with right (e.g., The temperature was just right.) and wh-words (e.g., I know just how to do it.) to yield a reading similar to exactly. This suggests that in those constructions it behaves as it does in equative constructions, conveying that the prejacent is to be interpreted at the highest level of precision.

References


The interaction of just with modified scalar predicates


“Just” don’t ask: Exclusives and potential questions
Alex WARSTADT — New York University

Abstract. The English exclusive just is not synonymous with other exclusives such as only in sentences like Sometimes, bad things just/only happen. I give a new analysis of just which explains this and other puzzling readings of just observed in earlier work (e.g. Wiegand, 2016; Beltrama, 2018). I argue that just excludes alternatives derived from a potential question, or possible future QUD, in the sense of Onea (2016). This new perspective makes it possible to give the first unified account of these non-canonical exclusive readings of just, and provides evidence that the semantics of lexical items can be sensitive to possible futures of the discourse.

Keywords: exclusives, potential question, QUD, discourse particle, alternatives, assertability.

1. Introduction

There is growing evidence that the semantics of certain lexical items makes reference to the structure of discourse. In particular, it has been proposed that the QUD stack (Roberts, 1996; Ginzburg, 1996) or Table (Farkas and Bruce, 2010) plays a crucial role in the lexical semantics of focus sensitive items like only (Beaver and Clark, 2008; Coppock and Beaver, 2013) discourse particles like German überhaupt (Rojas-Esponda, 2014), and polarity response particles like yes (Farkas and Roelofsen, 2011). While stack-based models track conversational goals that have been adopted prior in the discourse, less attention paid to the role of possible future conversational goals in grammar. Onea (2016) makes progress in this direction by proposing a theory of potential questions, intuitively possible future QUDs, and their role in grammar.

In this work, I propose that the English particle just makes direct reference to the future of the discourse as part of its conventional meaning in examples like (1). Specifically, if someone utters The lights in this place turn off and on— i.e. (1a) without just—a likely followup question is Why?. What just does is express that this followup question is unanswerable. It does so before the addressee can ask it, thus preventing the addressee from asking a useless question.

(1) a. The lights in this place just/#only turn off and on. UNEXPLANATORY
   (Paraphrase: The lights turn off and on for no apparent reason.)
   b. The pumpkin bisque is just/#only delicious! UNCONTRASTIVE
   (Paraphrase: The pumpkin bisque is extremely delicious.)
   c. Sue is not just/#only a teacher; she’s a math teacher. UNELABORATORY
   (Paraphrase: Sue is not a general teacher.)
   d. Betsy just/only eats soup. CANONICAL EXCLUSIVE/UNCONJUNCTIVE
   (Paraphrase: Betsy eats soup and nothing else.)

More generally, I argue that just is an exclusive operator over a potential question raised by prejacent, which prevents it being adopted as a QUD. Unlike strong exclusives which negate alternatives, I propose that just is a weak exclusive which declares alternatives unassertable, thereby freeing the speaker from taking a position on the potential question. This explains

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ignorance readings of *just* as in (1a), where we infer not that there is no reason whatsoever for the lights turning off and on, but that the speaker does not know the reason. Apparent strong readings of *just* can be derived from this weak exclusive analysis by pragmatic strengthening.

This account is the first to give a unified analysis of *just* that derives the set of non-canonical exclusive uses of *just* in (1a)-(1c) not shared with *only*, as well as the canonical exclusive flavor (1d). Building on prior work on non-canonical exclusives (Orenstein, 2015; Beltrama, 2016, 2018; Wiegand, 2016, 2018), I classify these uses descriptively into four “flavors” based on the kinds of discourse continuations they reject: explanations (1a), contrasts (1b), elaborations (1c), and conjunctions (1d). I argue that these different flavors do not represent different lexical entries of *just*, and are best viewed as excluding different types of potential questions.

The analysis of non-canonical readings of *just* has implications for theories of alternatives. These readings cannot be derived in standard analyses of exclusives, in which exclusives negate alternatives derived from focus (Rooth, 1985, 1992) or the current QUD (Beaver and Clark, 2008; Coppock and Beaver, 2013). Work on non-canonical exclusives has proposed new or modified mechanisms for generating alternatives, such as focus on covert content (Orenstein, 2015; Wiegand, 2016, 2018) or a syntactic algorithm following Katzir (2007) for generating metalinguistic alternatives (Beltrama, 2018). The present account is the first to suggest a potential question as the source of alternatives. This approach suggests a pragmatic explanation for why these readings arise, while avoiding some bad predictions of previous accounts.

Finally, the proposal also exposes important unanswered questions in the structure of discourse. Namely, how do conversational participants choose among the landscape of potential questions available as possible future QUDs at a given point in the discourse? The proposed analysis of *just* relies on the speaker being able to anticipate which potential question is most salient. Evidence from the interpretation of sentences involving *just* points to several linguistic and non-linguistic factors that influence these decisions, but ultimately these questions remain open.

The structure of this paper is as follows: Section 2 discusses the primary data to be accounted for. Section 3 defines and motivates potential questions. Section 4 gives the proposed analysis of *just* and discusses its predictions. Section 5 discusses related work. Section 6 concludes.

2. *Just* Data

*Just* is the most frequent exclusive in English.\(^2\) It is also highly polyfunctional (Lee, 1987, 1991; Aijmer, 2002). This section discusses the readings of *just* and the empirical scope of the present paper. First, I characterize the distinction between strong and weak exclusion. Then, I discuss four flavors of *just* that the proposed analysis unifies. Finally, I discuss readings not covered under the account, and consider arguments against unifying these readings.

2.1. Strong vs. Weak Exclusion

Sometimes, *just* makes a very clear truth conditional contribution, while at other times it seems to convey something about discourse. Consider (2a), which expresses Aristotle’s view that flies

\(^2\) *Just* is the 66\(^{th}\) most frequent word in the Corpus of Contemporary American English (COCA; Davies, 2009). *Only* is 101\(^{st}\). In a random sample of 100 instances in COCA, 19% are non-exclusive uses, such as specificatory *just* or the adjective meaning fair. After removing these instances, *just* is 18% more frequent than *only.*
appear in rotting fruit entirely without cause. This sentence is false, and spontaneous generation is (rightly) disproved, if an explanation for the prejacent is found. By contrast, Wiegand (2016) notes that the speaker in (2b) does not make a similarly strong claim that the lights turn off and on for no reason whatsoever. Instead, they convey they are ignorant of the cause for lights’ turning off and on. While they may suspect a ghost is responsible, they are ultimately unsure.

(2) a. Context: Aristotle is explaining his view of spontaneous generation.
   Flies just appear in rotting fruit. **STRONG EXCLUSION**
   
   b. Context: The speaker is explaining why they think their house may be haunted.
   The lights just turn off and on. **WEAK EXCLUSION**

Examples (2a) and (2b) illustrate what I refer to as strong exclusion and weak exclusion, respectively. One contrast between examples of this type is that strong exclusives cannot be followed up with claims to the effect that some of the relevant alternatives may be true (3a), while, as Wiegand (2016) notes, weak exclusives allow such followups (3b):

(3) a. Aristotle: Flies just appear in rotting fruit. # They may be hatching from eggs.
   b. The lights just turn off and on. A ghost may be flipping the switch.

In addition to conveying speaker ignorance, weak just can also convey reluctance to answer certain questions (4a) or irrelevance of a question (4b):

(4) a. A: Why did Skip break up with you?
   B: They just did. *(paraphrase: I’d rather not say why.)*
   
   b. A: I was on my way to the hospital to deliver a baby when the train stopped.
   B: Why did it stop?
   A: It just did. Anyway, I missed the delivery. *(paraphrase: It doesn’t matter why.)*

2.2. Four Flavors of Exclusive just

Prior literature on just has identified various sub-types of just which can arguably be analyzed as either a weak or strong exclusive. I identify four primary flavors based upon the kind of discourse continuation that is made infelicitous by just. While these categories are a convenient descriptive tool, they play no formal role in the analysis, and do not necessarily exhaust the range of interpretations of just that can be observed or that follow from the account. Furthermore, as I discuss in Section 4.2, the interpretation of just is highly flexible and context sensitive, and so a given example may be consistent with numerous flavors and paraphrases.

**Unexplanatory just** In the unexplanatory flavor first identified by Wiegand (2016), just conveys that there is no explanation for the prejacent. This meaning is not expressible with only:

(5) a. The lights in this place just/#only turn off and on.
   *(Paraphrase: There is no (known) reason why.)*
   
   b. Last week, a piano just/#only fell from the sky onto Fifth Avenue.
   *(Paraphrase: There is no (known) reason why.)*

As shown in (6), attempts to follow up unexplanatory just with an explanation result in oddness (while without just, such a followup is perfectly natural). If strong just is intended, these examples result in a contradiction, even if the explanation is modalized, as already shown
in (3a). If weak *just* is intended, unmodalized explanations are infelicitous (6), but rather than contradiction, one gets the impression that the speaker has unexpectedly changed their epistemic state or communicative goals: while at first they were unable or unwilling to give an explanation, they have subsequently done so.  

(6) # The lights just turn off and on. The wire is frayed.

**Uncontrastive just**  
Lee (1987), Beltrama (2016, 2018), and Wiegand (2016) have observed that *just* can give rise to an intensification effect (7). Again, this reading does not arise with *only*; in fact, when felicitous *only* has an attenuating effect. I refer to this as the **uncontrastive** flavor as it is infelicitous to give a followup that stands in the contrast relation (Asher and Lascarides, 2003) to the prejacent (8). Again, under the strong interpretation of *just*, these followups stand in contradiction to the first assertion. On the weak interpretation, one gets the impression that the speaker was being misleading, or indecisive.

(7) a. The pumpkin bisque is just/#only delicious. (**paraphrase:** It’s extremely delicious.)  
   b. The engine just won’t start. (**paraphrase:** There is no recourse.)  
   c. That kind of behavior is just not okay. (**paraphrase:** There is no exception.)

(8) a. #The pumpkin bisque is just delicious. But there’s a little too much garlic.  
   b. #The engine just won’t start. But it will if I jump start the battery.  
   c. #That kind of behavior just not okay. But it is if you get permission first.

Morzycki (2011) observes that this flavor of *just* resembles intensifiers like *flat out* and *positively* in that it is able to modify so-called **extreme adjectives** that mark the endpoint of a scale like *delicious*, but cannot modify “ordinary” gradable adjectives like *tasty* (9). Beltrama (2018) notes that this flavor of *just* has a wider syntactic distribution than a intensifier, and felicitously modifies other expressions that mark scalar endpoints, such as modals with universal force (7b).

(9) #The pumpkin bisque is {just/flat out/positively} tasty.  
   (intended: The pumpkin bisque is extremely tasty.)

**Unelaboratory just**  
The **unelaboratory** flavor of *just*, first discussed by Orenstein (2015) in Hebrew, rejects possible elaborations on the prejacent. It is useful to separate the predicative case (10), from other cases (11).

(10) a. Sue is not just a language teacher; she’s a French teacher.  
   b. A: What kind of dog is Fido?  
      B: Fido is just a dog. (**paraphrase:** Fido is an ordinary dog, or a mutt.)  
   c. **Context:** A teacher explaining the pH scale to high school students.  
      A proton is just a hydrogen atom without an electron.  
      (**paraphrase:** No more elaborate description is needed to define a proton.)

(11) a. I’m not mad at you. I’m just mad. (**paraphrase:** I’m not mad at anyone.)

If yet another flavor of *just* is meant, these examples could be felicitous. For instance, suppose the lights are a prop in a play meant to represent flashes of lightning. The props director can felicitously utter (6) to convey that no special action is needed to make the lights to turn off and on because the wire is frayed. However, *just* would no longer be excluding an explanation, but a manner of inducing the lights to turn off and on.
b. A: What are you up to?
   B: I’m just reading. (paraphrase: What I’m reading is not of interest.)
c. Usually I have to say “hocus-pocus” to open the gate, but today it just opened.
   (paraphrase: I didn’t have to say “hocus-pocus”.)
d. Betsy just walked over and shook the president’s hand.
   (paraphrase: Betsy walked over without much ado.)

In each example discourse continuations that elaborate on the prejacent are infelicitous (12). Both the strong and weak readings are available, though in the predicative case, the strong reading is implausible. For instance, if Fido is a dog, Fido must be a specific type of dog. Thus, the weak reading is most natural, in which his breed is unknown or irrelevant. By contrast, strong reading is most natural in (11c), in which the speaker did not have to say “hocus-pocus”.

(12) a. #Fido is just a dog. In fact, he’s a dalmatian.
   b. #Betsy just shook the president’s hand. She had to pass a secret service check first.
   c. #I’m just mad. In particular, I’m mad at you.

The non-predicative cases (11) can be distinguished based on whether the excluded elaboration expresses an implicit argument. Examples (11a-11b) involve an implicit argument: if one is mad, one is usually mad at something; and one cannot read without reading something. Examples (11c-11d) do not involve an implicit argument, but rather a manner or sub-process of an event. For instance, (11b) can be understood to say that Betsy did not seek permission from the president or the secret service before walking over and shaking the president’s hand.

**Unconjunctive (Canonical Exclusive) just**  
Of all the flavors of just, the unconjunctive, or canonical exclusive use, has been the best studied. It shares many properties with only (13): it denies alternatives to the prejacent, it (tends to) presuppose its prejacent\(^4\) (Horn, 1969), and it is focus-sensitive (Rooth, 1985).\(^5\)

(13) a. Betsy just/only eats [CHICKEN NUGGETS]\(^F\).
   \(\vdash\) Betsy doesn’t eat hot dogs.  
   alternative denial
b. Betsy doesn’t just/only eat [CHICKEN NUGGETS]\(^F\). She eats hot dogs!
   \(\vdash\) Betsy eats chicken nuggets. 
   prejacent presupposition
c. Betsy just/only [EATS]\(^F\) chicken nuggets.
   \(\vdash\) Betsy doesn’t make chicken nuggets.
   focus sensitivity

For our purposes, the main point of contrast between unconjunctive just and only is the availability of weak exclusion. While strong just is certainly more commonly observed in connection with this flavor (a fact I have no explanation for), a weak reading is available in (14). In (14B), the response with just seems to indicate that the speaker isn’t doing anything of relevance besides sitting. By contrast, only really resists this weak interpretation: the response comes out as false because the speaker is also biting their finger nails.\(^6\)

\(^4\)The nature or even existence of this presupposition has been widely debated (Horn, 1996; Roberts, 2011: i.a.). I set aside this issue for reasons of space.

\(^5\)I also set aside some contrasts between just and only noted by Coppock and Beaver (2013). For instance under negation just appears to presuppose its prejacent, while only does (e.g. Betsy is not just/#only an admiral, she’s a general.). Furthermore, only, but not just, adjoins to DPs (e.g. Only/#Just Betsy saw the fox.).

\(^6\)Craige Roberts (p.c.) suggests an alternative explanation for the oddness of B’: only requires a salient alternative
(14) **Context:** B is sitting on the floor biting their finger nails.
A: What are you doing?
B: I’m just/# only sitting here.

2.3. Meanings not to be discussed

Finally, there are several meanings of *just* that I do not attempt to unify under the account. Many of these readings have been discussed in literature on discourse markers (Lee, 1987; Schiffrin, 1988; Aijmer, 2002; Molina and Romano, 2012: i.a.). The **temporal** usage (15a), expresses that the event denoted by the prejacent occurred immediately before the clause’s reference time (Laparle and Truswell, 2018). The **specificatory or approximative** usage has been argued to restrict a scalar predicate to only those degrees close to some point on the scale (Laparle and Truswell, 2018; Thomas, 2020). The **scalar** usage (15e) expresses that the prejacent is low on some relevant scale (Klinedinst, 2004).

(15) a. The train just left. **TEMPORAL**
b. The yoga studio is just past the juice bar. **SPECIFICATORY/APPROXIMATIVE**
c. I know just who to ask for advice. **SPECIFICATORY/APPROXIMATIVE**
d. John is just as tall as/taller than Mary. **SPECIFICATORY/APPROXIMATIVE**
e. Is it strep, or just a viral infection? **SCALAR**

There is reason to suspect that the non-canonical exclusive readings of *just* in (1a)-(1c) form a natural class, to the exclusion of the temporal and approximative readings. English *simply*—unlike *only*—in fact does express the full range of non-canonical readings as *just*, but not the temporal or approximative reading. A unified analysis of these non-canonical readings is called for to explain why these meanings and not others are expressed by the same lexical items.

Nonetheless, there is likely some relation between these various readings of *just*. It may be possible to argue in the spirit of Klinedinst (2004), Beaver and Clark (2008), and Coppock and Beaver (2013) that all the readings of *just* possess some scalar component as in (15e). Thomas (2020) argues that approximative *just*, like canonical exclusives, denies alternatives stronger than the prejacent. There is a sense in which the discourse continuations excluded by non-canonical exclusives are more complex than the prejacent. I leave further development of this approach to future work.

3. Potential Questions

The proposed analysis of *just* relies on the notion of a potential question, inspired by Onea (2016). Intuitively, potential questions are possible future QUDs which can be raised upon learning a new piece of information. This section defines and motivates this notion.

3.1. Technical Background

First, I clarify my technical assumptions. I assume a dynamic view of discourse following Stalnaker (1978) and Roberts (1996), in which the discourse context $C$ is a tuple $\langle cs, QUD, S, A \rangle$ set from earlier in the discourse, and in this case none can be found. If we are in a context where A suspects B of doing something naughty, then B’ with *only* is improved. This contrast then would reflect the fact that while *only* looks retrospectively for an alternative set, *just* looks prospectively.
where of the \( cs \) is the \textbf{context set}, \( QUD \) is the \textbf{QUD stack}, and \( S \) and \( A \) are the speaker and addressee respectively. The context set is the largest (nonempty) set of possible worlds consistent with the common beliefs of all the discourse participants, and the QUD stack is a set of questions (explicit or implicit) accepted by the interlocutors and ordered by precedence. The \textbf{current QUD} \( CQ \) is the element on top of the stack (i.e. the most recent). In the spirit of Groenendijk and Stokhof (1984), I assume that interrogatives denote a set of alternative nonempty propositions that form a \textbf{partition} over the context set and represent the exhaustive answers to the question.\footnote{There has been considerable debate over whether the partition view of questions is adequate for questions that are not strongly exhaustive (e.g., Beck and Rullmann, 1999; van Rooy and Schulz, 2004). For simplicity, I restrict my discussion to strongly exhaustive questions.} Note that Onea (2016) implements his theory of potential questions in inquisitive semantics (Ciardelli et al., 2018). To my knowledge, it is possible with some modifications to adapt my analysis to inquisitive semantics.

3.2. Motivation & Definition

Onea’s (2016) motivation for potential questions comes from general observations about discourse. In the QUD model (Roberts, 1996; Ginzburg, 1996), new information is generally seen as addressing the current QUD. However, this view does not capture occasions where new information actually raises a new question. In the dialogue in (16), B1 addresses question A1, but also raises question A2. By contrast, B1’, though relevant to A1, does not raise A2. The notion of a potential question gives a formal explanation for this contrast. The intuition is that A2 is likely to have a positive true answer given B1 but not B1’.

(16) \hspace{1em} A1: How is John doing? \\
\hspace{1em} B1: He recently had car accident. / B1’: Sue just broke up with him. \\
\hspace{1em} A2: Is he injured? (# in response to B1’)

Potential questionhood imposes constraints on future QUDs that are supplementary to constraints already present in QUD theory. In Roberts’s (1996) proposal, a new QUD is felicitably askable only if it is relevant to the current QUD, as defined in (17) and illustrated in Figure 1. For concreteness, if \( Q_1 \) is \textit{Who ate what?}, then a relevant followup question \( Q_2 \) could be \textit{What did Betsy eat?}. Assuming the context set is consistent with several options for what Betsy ate,
then $Q_2$ meets the condition in (17) because any answer exhaustively describing what Betsy ate would eliminate from consideration at least one exhaustive description of who ate what.

\[(17) \quad \text{Question } Q \text{ is relevant to the current QUD } CQ \text{ iff } \forall a \in Q \exists a' \in CQ. a \cap a' = \emptyset\]

Returning to example (16), relevance cannot account for the infelicity of $A_2$ in response to $B_1'$. Question $A_2$ is actually a relevant followup question to $A_1$ according to (17) regardless of the content of $B_1$ or $B_1'$. An exhaustive description of how John is doing includes whether or not he is injured, so either answer to $A_2$ will eliminate at least one answer to $A_1$. The problem is not that relevance is formulated incorrectly (intuitively, to know whether John is injured is relevant to how John is doing), but rather that it is not a sufficient condition for felicity.

The solution in this case is to add the constraint that a new QUD must be a potential question in the discourse context. In (18) I adapt Onea’s (2016) definition of a potential question. Question $A_2$ in (16) is a potential question following $B_1$ but not $B_1'$, because upon learning that John had an accident, it is highly likely that he is injured, but not so upon learning he was broken up with. In this dialogue, we say that $B_1$, but not $B_1'$, licenses $A_2$ as a potential question (18b), because updating the context set with $B_1$ results in $A_2$ becoming a potential question.

\[(18) \quad \text{Definition: Potential question} \quad \text{Question } Q \text{ is a potential question in context } C \text{ iff (a) } Q \text{ is sufficiently likely to have a positive true answer given } cs_C, (b) Q \text{ is not resolved by } cs_C, \text{ and (c) } Q \text{ is not an element of } QUD_C. \text{ This is written } PQ_C(Q).\]

\[\text{b. Definition: Licensing a potential question} \quad \text{Proposition } p \text{ licenses } Q \text{ as a potential question in } C \text{ iff } PQ_C[p](Q), \text{ but not } PQ_C(Q), \text{ where } C[p] \text{ is the result of updating } C \text{ with } p. \text{ This is written } LICENSE_C(p, Q).\]

These definitions also apply to $wh$-questions, in which case a positive answer is any exhaustive answer besides the universal negative answer. Consider example (19), illustrated in Figure 2. Although both question $A_2$ and $A_2'$ are relevant to the initial QUD, B’s response licenses only $A_2$. This is because upon learning that the cookies disappeared, it is likely that someone ate them, but not that someone hid them. This is clear from Figure 2: The size of the white
region represents the probability that the question has a positive true answer, and one can see a marked difference between questions A2 and A2’ in the size of this region. This presupposes an ordinary context. If participant A lives with several mischievous children who hide her things, then the white region in A2’ would be much larger, and as predicted the question would be felicitous.

(19) A1: What happened to the cookies I was saving for the holiday party?
   B: They’re not in the cabinet anymore.
   A2: Who ate them? / A2’: # Who hid them?

3.2.1. Potential Questionhood vs. Existential Presupposition

An alternative hypothesis to explain the badness of the response in (19) is that an existential presupposition of the question is not satisfied in the context. I reject this hypothesis for two main reasons. First, presupposition failure cannot explain the oddness of the followup polar question in (16) in response to B1’, since a polar question clearly cannot presuppose its positive answer. Second, appealing to presupposition failure to explain the badness of (19A2’) should equally predict badness in the case of (19A2), since the speaker’s beliefs do not incontrovertibly entail the existential proposition.

I side with Groenendijk and Stokhof (1984), Onea (2016), and many others in the view that wh-questions do not have an existential presupposition by virtue of their semantics. In support of this view, Groenendijk and Stokhof (1984) argue that a universal negative answer is a felicitous response to a wh-question (20B), and Onea (2016) provides further evidence that such responses do not behave like rejections of a presupposition (20B’).

(20) A: Who is coming with me?
   B: Nobody / B’: # Hey wait a minute, nobody’s going with you!

Instead, Onea’s (2016) theory gives a pragmatic explanation for this existential inference. In order for Q to be a potential question, the existential proposition must be likely to be true. Hence, if an agent asked Q, they must assign high probability to the existential proposition. This view builds on prior work in inquisitive semantics that argues that positive answers of a question have a special “highlighted” status (Roelofsen and Van Gool, 2010; Roelofsen and Farkas, 2015). I import the notion of highlighted alternatives into Groenendijk and Stokhof (1984) partition semantics for questions, using \( H(Q) \) to denote Q’s highlighted alternatives.

3.3. Raising Potential Questions

Even a potential question may be a bad candidates for a new QUD. For example, (16B1) licenses all the questions in (21), and each one is relevant to the original QUD How is John
doing?). However most speakers would be unlikely to ask any of them in this context.

(21) Does he have insurance? / How fast was he going? / Did he mess up his hair?

While a new piece of information can license many potential questions, for a given participant and discourse context it makes sense to say that it only raises one question: the question that agent is most inclined to ask (22). I follow Onea (2016: p. 135) in assuming that potential questions can be ordered by salience (though I assume a total order).

(22) **Definition: Raising a Potential Question**

Potential question $Q$ is raised by proposition $p$ in context $C$ only if it is the highest ranked $Q$ such that $\text{LICENSE}_C(p, Q)$ according to total order $<_A$ determined by salience to agent $A$. This is written $\text{RAISE}_C(p, Q, A)$.

I consider it uncontroversial that a given agent has the reasoning necessary to arrive at a unique most salient potential question. Otherwise, we would be unable to choose a followup question in discourse. However, we are still far from a theory of salience, and such a theory will likely lie at the interface of pragmatics and psychology (McCready, 2012; Onea, 2016) and involve various interrelated factors. Nonetheless, there are still some meaningful linguistic generalizations to be made about salience. McCready (2012) suggests a notion of salience for QUDs based on van Rooy’s (2003) insight that questions can be ordered by utility. Onea (2016: p. 136) identifies certain indefinites and implicit arguments as types of linguistic content that tend to raise elaboration or specificational questions. I leave a more complete analysis of salience and raising potential questions to future work and subsequently take these notions as given.

4. Analyzing *just*

The proposed lexical entry for *just* is given in (23). A schematic comparison of *just* and *only* is given in Table 1. I propose that *just*, like other exclusive operators such as *only*, rejects a set of propositional alternatives to the prejacent. However, it differs from *only* in two ways: First, the set of alternatives to the prejacent, which I call $\text{PQ-ALT}_C(p)$ (23b), comes from the potential question raised by $p$ in the context with respect to the addressee $A_C$. Second, the alternatives are rejected by virtue of being unassertable for the speaker $S_C$, rather than false.

(23) a. $\llbracket \text{just} \rrbracket^C = \lambda \text{p} \lambda w : p(w). \forall a \in \text{PQ-ALT}_C(p) [\neg \text{ASSERTABLE}(a, S_C, w)]$

b. $\text{PQ-ALT}_C(p) := \mathcal{F}(1Q[\text{RAISE}_C(p, Q, A_C)])$

---

**Table 1: Schematic analyses of *just* and *only***

<table>
<thead>
<tr>
<th></th>
<th><em>just</em></th>
<th><em>only</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argument</td>
<td>Prejacent proposition $p$</td>
<td>Prejacent proposition $p$</td>
</tr>
<tr>
<td>Presupposition</td>
<td>$p$ is true</td>
<td>$p$ is true</td>
</tr>
<tr>
<td>Alternatives</td>
<td>The potential question raised by $p$</td>
<td>The current QUD, focus congruent to $p$</td>
</tr>
<tr>
<td>Exclusion</td>
<td>All positive (highlighted) alternatives to the PQ are unassertable</td>
<td>All alternatives not entailed by $p$ are false</td>
</tr>
</tbody>
</table>

---

10I propose *just* excludes only highlighted alternatives for two reasons: This is the smallest set of alternatives whose exclusion makes the potential question unaskable, and excluding all cells in a partition gives a contradiction.
The notion of assertability (23a) is defined in (24) as a conjunction of conditions that a proposition must satisfy to be felicitous and rational to assert. Conditions (a) and (b) can be derived from Grice’s (1975) maxims of quality and relation, respectively. The third condition is not entirely Gricean, because it comes into play in uncooperative discourses, such as a police interrogation, where a participant may selfishly refuse to make an assertion. Thus, just conveys that each alternative fails at least one of these conditions in the actual world. As noted in Section 2.1, weak just can be used to express that the speaker does not know whether the alternatives are true, considers them irrelevant, or is unwilling to assert them. With sufficient context, the listener can strengthen the claim that an alternative is unassertable to the claim that one particular condition in (24) fails to be met.

(24) **Definition: Assertability**

Proposition $p$ is assertable for agent $A$ in $w$ iff: (a) $S$ believes in $w$ that $p$ is true, (b) $S$ considers $p$ relevant to the other conversational participants in $w$, and (c) $S$ is willing to be publicly committed to believing $p$ in $w$. This is written $\text{ASSERTABLE}(a, S, C, w).

Recall that just also has a strong reading, as in (2a). I suggest that this reading is pragmatically derived from the weak exclusive lexical entry in (23) when the addressee assumes the speaker is opinionated about the potential question. This is completely parallel to the opinionatedness assumption that has been argued to strengthen weak (or primary) implicatures (Sauerland, 2004). For example, in (2a) the strong reading arises because we assume that Aristotle, as a philosopher seeking to give an explanation, has an opinion about the cause of fruit flies appearing. Since he considers no cause to be assertable (and the relevance and willingness conditions on assertability are met), he must believe there is no cause whatsoever.

Note that I have posited a presupposition for just in (23). Non-canonical just triggers a soft presupposition that the prejacent is true (25a), but this is often absent (25b). Since it is still debated whether soft presuppositions are semantically encoded (e.g. Abusch, 2010), I leave open the possibility that the prejacent inference arises by other means.

(25) a. John didn’t just leave class. He notified the professor first. $\rightarrow$ John left class.
   b. Does the landlord just show up, or does he stay away? $\not\rightarrow$ The landlord shows up.

4.1. Unifying Non-Canonical Exclusion

We can now show how the various flavors of just introduced in (1), repeated in (26), are derived from the lexical entry for just in (23). As discussed in Section 2, each flavor prevents discourse continuations that stand in certain rhetorical relations to the prejacent. This follows under the analysis from the fact that different rhetorical relations can be seen as different types of QUDs (see Onea, 2016: §8.3). Examples of each kind of excluded question are given in (27).

(26) a. The lights in this place just turn off and on. $\text{UNEXPLANATORY}$
   b. The pumpkin bisque is just delicious! $\text{UNCONTRASTIVE}$
   c. Sue is not just a teacher; she’s a math teacher. $\text{UNELABORATORY}$
   d. Betsy just eats soup. $\text{UNCONJUNCTIVE}$

---

11 One might want $p$’s assertability to be a property of an information state instead. This is possible in a framework like inquisitive semantics or the commitment space model of Cohen and Krifka (2014) where the type of the discourse context is lifted to be a set of information states (or similar). I leave such an analysis for future work.
First, the unexplanatory flavor in (26a) arises when the prejacent of just raises an explanation question, as in (27a). This potential question is licensed by the prejacent (see definition (18b)) because upon learning that the lights turn off and on—but not sooner—it is highly likely that there is some explanation for the flickering. It is raised (see definition (22)) in contexts where this is the most salient potential question. The fact that this reading is easily accessible in a relatively neutral context follows from the assumption that explanation questions are among the kinds of potential questions that can be maximally salient by default (Onea, 2016: p. 136). In this example, just contributes that each possible explanation is unassertable, most likely because the speaker lacks sufficient evidence.

Second, the uncontrastive flavor in (26b) arises when the prejacent raises a contrast question, as in (27b). This explains the intensification effect associated with this flavor. The reasoning follows Beltrama’s (2018) analysis in many respects (though see Section 5.3 for more discussion of Beltrama’s analysis). Even if the pumpkin bisque is slightly less than delicious, it can be described as delicious without violating the maxim of quality, once we consider the pragmatic halo around delicious (Lasersohn, 1999). Rational speakers may make such slightly exaggerated claims in response to Gricean pressures to keep utterances brief. One consequence of this behavior is that the addressee may wrongly infer that the speaker is exaggerating when making a justified strong claim. The contribution of just is that no contrasting statement is assertable, perhaps because they are all false, and thus the speaker is not exaggerating. In fact as the competitor’s question in (28) illustrates, the stronger the claim, the more likely a contrast question is to be raised. This explains why uncontrastive just is available primarily with extreme adjectives (9): contrast questions are maximally salient primarily in connection with extreme claims.

Third, the unelaboratory flavor of just in (26c) arises when the prejacent raises an elaboration question, as in (27c). Upon learning that Sue is a teacher, it is natural to wonder what kind of teacher she is. In this example, the prejacent attributes to Sue the property of being a teacher, and the elaboration question contains various modifications (subsets) of this property. Interestingly, just is embedded under negation,² so rather than conveying that no modification is assertable, the first clause of (26c) conveys that there is an assertable alternative to the potential

²Nothing in the lexical entry in (23) prevents just from appearing in embedded positions. However, Beltrama (2018) observes specific examples in which just do not embed under negation (e.g. # The soup is not just delicious). I leave a detailed investigation of the embeddability of just to future work.
question, which the second clause supplies. In other cases of unelaboratory just, such as (11a), the presence of an implicit argument raises a specificational question about the referent of the argument. This supports the view that that implicit arguments make such potential questions highly salient by default (Onea, 2016: p. 136).

Finally, the unconjunctive—or canonical exclusive—flavor of just can be derived in cases where the prejacent raises a conjunction question, as in (27d). I assume that such questions have an additive presupposition, in this case that Betsy eats soup. The fact that Betsy eats soup licenses this potential question because prior to learning this fact, each of the positive answers to (27d) has probability 0 due to the failure to satisfy the additive presupposition. If we assume that the QUD concerns what Betsy eats, then this is the most salient potential question. Recall that according to Coppock and Beaver (2013), only excludes alternatives from the current QUD. Arguably, the reason that this flavor of just is equivalent to the one arising from only is that the potential conjunction question is actually equivalent to the QUD after updating the context set with the prejacent.

4.2. Context Sensitivity and Salience

The account of just in (23) predicts a high degree of context sensitivity due to the claim that just excludes the potential question with the greatest contextual salience. Rather than being a limitation, I argue that this is a necessary feature of an adequate account of just. As explained at the top of Section 2.2, the four categories of just’s meanings I propose are used heuristically, and there are instances where just excludes a contextually salient potential question that is not easily categorized.

For example, consider example (11c), repeated in (29). In this sentence just excludes a single alternative, namely the positive answer to the question Did the speaker have to say “hocus-pocus” when opening the gate?. This alternative set is highly specific to the context and highly salient, hence this reading is only predicted if just retrieves its alternative set from the context.

(29) Usually I have to say “hocus-pocus” to open the gate. But today it just opened.

\[
PQ\text{-ALT}_c(\text{The gate opened}) = \mathcal{H}(\{\text{Did S say “hocus-pocus” to open the gate?}\}) = \{S \text{ said “hocus pocus” to open the gate.}\}
\]

Similarly, the interpretation of just can be altered based on other factors that determine the salience ordering over potential questions, such as consistency and relevance to the participants’ goals. These factors can be sufficient to override the default interpretation of just. For example, the string I just love him is most naturally interpreted with uncontrastive just (i.e. with an intensification reading). However, in (30), it carries an unexplanatory reading, because the uncontrastive reading would be inconsistent with the prior context. Similarly, the string the lights just turn off and on (1a) most naturally had an unexplanatory reading in a neutral context. However in (31), we instead get the reading that no additional action is necessary to operate the lights. This is because the potential question of how the light is operated is relevant to the QUD, while the potential explanation question is not.

(30) I know Justin Bieber is a bit of a jerk and a mediocre singer. I just love him.

Paraphrase: I can’t explain why I love him.
Table 2: Comparison of accounts of *just* and other non-canonical exclusives.

<table>
<thead>
<tr>
<th>Account</th>
<th>Flavor</th>
<th>Alternative source</th>
<th>Weak/Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coppock &amp; Beaver (2013)</td>
<td>Unconjunctive</td>
<td>QUD-based alts</td>
<td>Strong</td>
</tr>
<tr>
<td>Orenstein (2015)</td>
<td>Unelaboratory</td>
<td>Roothian “internal” alts</td>
<td>Strong</td>
</tr>
<tr>
<td>Wiegand (2016, 2018)</td>
<td>Unexplanatory</td>
<td>Roothian “internal” alts</td>
<td>Modal alts</td>
</tr>
<tr>
<td>Beltrama (2016, 2018)</td>
<td>Unelaboratory</td>
<td>Metalinguistic alts</td>
<td>Weak</td>
</tr>
<tr>
<td>Present account</td>
<td>All of the above</td>
<td>Potential Question</td>
<td>Strengthening</td>
</tr>
</tbody>
</table>

(31) 
Context: The props director for a play is explaining to a stage technician how to use a special light that creates the effect of lightning flashes. Flip the switch, and the lights just turn off and on.

5. Comparison to Previous Work

The present analysis of *just* builds on details from prior accounts of *just* and non-canonical exclusives. It also diverges in some key respects, and in some cases it addresses empirical and theoretical problems of previous accounts. Table 2 summarizes key points of divergence.

5.1. QUD-based Alternatives

Beaver and Clark (2008) and Coppock and Beaver (2013) develop a theory of exclusive particles in which alternatives come from the current QUD. Coppock and Beaver give a very general analysis for a wide array of exclusives in English, including *just*, but largely overlook non-canonical readings of *just*. Despite the similarities between the QUD and potential questions, this account does not predict non-canonical readings of *just*, as the alternative set excluded by *just* is not generally the current QUD. For example, consider the dialogue in (32). A’s question acts as the QUD at the time of B’s utterance with *just*, while the excluded alternatives come from another question: *Why do the lights turn off and on?*. This question was not even entertainable as a QUD because A was unaware that the lights were turning off.

(32) A: Why are you afraid of your apartment?
    B: The lights just turn off and on.

5.2. Focus Alternatives & Covert Modifiers

Orenstein (2015) and Wiegand (2016, 2018) give accounts of unelaboratory and unexplanatory exclusion (respectively) in which excluded alternatives are focus-generated.\(^{13}\) Their analyses derive virtually the same alternative sets for these flavors as the present account, as in (27a) and (27c). However, they follow Rooth (1985, 1992) in supposing that the alternatives are generated by replacing a focused element in the prejacent with other semantic values of the same type. The technical puzzle for this approach is that the alternatives for these flavors vary by *adding* some content to the prejacent, not by replacement. To address this, they both propose that the focused element in the prejacent is a covert modifier with a trivial semantic contribution.

\(^{13}\)Orenstein (2015) does not analyze *just*, but rather the Hebrew exclusive *stam*. 
For example, in the case of unelaboratory just (33), a covert nominal modifier is focused in the prejacent (covert content is crossed out). The modifier itself is trivial, i.e. it returns true for every individual, so it does not alter the ordinary meaning of prejacent. However, the replacements of the modifier are not trivial, giving the set of elaborations on the prejacent. Similarly, Wiegand (2016) posits a covert cause modifier to account for unexplanatory just.

(33) a. \( p = \text{Sue is a } [\text{MOD} \text{F}] \text{ teacher} \).
    b. \( [p] ; = \{ \text{Sue is a } Q \text{ teacher} \mid Q \in D_{\{e,f\}} \} = \{ \text{Sue is a math teacher}, \ldots \} \)
    c. \( [\text{MOD}]^o = \lambda x.e \cdot \top \)

Although this account generates the same alternative sets as the potential question account, it does not make the same predictions. In fact, it wrongly predicts that only should give rise to the same set of non-canonical readings as just. The reason is that both only and just exclude focus alternatives in this view. If alternatives generated by focus on covert modifiers can be excluded by just, there is nothing that should stop only from excluding these alternative as well.\(^{14}\) Another critique, albeit a purely theoretical one, is that it is not independently motivated to suppose that covert modifiers of this kind exist in the syntax.\(^{15}\) In principle, such modifiers should be generally available even in sentences without just, but with no observable effect. All else being equal, we should prefer an account that does not posit trivial covert content.

The potential question analysis avoids both pitfalls. The unavailability of non-canonical readings with only is easy to explain: only gets its alternatives from the QUD. And the “extra” material in the alternatives does not arise arbitrarily, but from pragmatic reasoning about future developments in the discourse and the independently motivated notion of a potential question.

5.3. Metalinguistic Alternatives

Beltrama (2018) gives an account that is focused on deriving the intensification effect of uncontrastive just in connection with extreme adjectives, as in example (26b). Beltrama’s account resembles the present one in several respects. First, it argues that just (and simply) express that certain alternatives to the prejacent are unassertable. Second, it derives intensification by restricting the excluded alternatives to versions of the prejacent with the addition of some contrasting piece of information. However, Beltrama does not suggest that just’s alternatives come from a potential questions, but rather argues that they are generated by a syntactic algorithm following Katzir (2007) which may insert, delete, contract, or replace constituents in the syntactic structure of the prejacent. Applying this algorithm to the prejacent \( p \) gives the metalinguistic alternatives of the prejacent, denoted \( \text{Alt}_{ML}(p) \). These alternatives can be ordered by syntactic complexity as in (34a), and Beltrama uses this ordering to define assertability, also following Katzir, in (34b).

(34) a. **Structural Complexity** Let \( \phi, \psi \) be parse trees. If we can transform \( \phi \) into \( \psi \)

\(^{14}\)In subsequent work, Wiegand (2018) addresses this problem by proposing two mechanisms for introducing alternatives: one is focus in the sense of Rooth (1992), and one is a formally similar mechanism that is triggered by covert modifiers. Accordingly, only selects for the first kind of alternatives, while just selects for the second. While this proposal avoids the problem of the original account, the solution is ad hoc.

\(^{15}\)Barker (2013) suggests that sprouting as in Sue is a teacher, but I don’t know what kind can be analyzed by proposing a covert modifier in the antecedent clause. However, other analyses do not propose covert modifiers (Chung et al., 1995), and even rely on notions closely related to potential questions (AnderBois, 2014).
by a finite series of deletions, contractions, and replacements of constituents in $\phi$ [...], we will write $\psi \leq_{\text{Com}} \phi$. (Beltrama, 2018: p. 9)

b. **Assertability** A proposition $p$ is assertable if there is no metalinguistic alternative $q$ such that $q$ is true and supported by evidence, and $q \leq_{\text{Com}} p$ or $q \subset p$, i.e. $q$ is less complex or more informative than $p$ (based on Beltrama, 2018: p. 12)

Finally, the proposed contribution of *just* is given in (35). This lexical entry says that any metalinguistic alternative to the prejacent that is assertable must also be at least as simple. This rules out from being assertable the metalinguistic alternatives in (36). The effect is to convey that the current situation is not one where the speaker is exaggerating slightly in calling the soup delicious. In such a situation, the metalinguistic alternatives are assertable despite being more complex than the prejacent, because they are more informative. Note that the prejacent is still assertable because it is simpler, and true within the pragmatic halo of *delicious*. Thus the source of the intensification effect is much the same as in the present account.

(35) $[\text{just}_{\text{Beltrama}}] = \lambda \alpha : \forall \beta \in \text{Alt}_{\text{ML}}(\alpha)[\text{ASSERTABLE}(\phi[\beta/\alpha]) \rightarrow \beta \leq_{\text{Com}} \alpha]$

(36) $\alpha = \text{delicious}; \text{Alt}_{\text{ML}}(\alpha) = \{\text{delicious but a little salty, delicious but too garlicky, ...}\}$

However, the metalinguistic account does not address how to restrict the alternatives such that they all address the same question. Adding relevance to the QUD as another constraint on assertability solves the problem for unconstrastive *just* if we assume the QUD for (26b) was, for instance, *How tasty is the pumpkin bisque?*. However, this cannot capture other non-canonical flavors of *just* since the QUD cannot be the source of the alternatives (see Section 5.1).

### 6. Conclusion

This paper gives an account that unifies several meanings of *just*. The account has implications for semantic theories of exclusives. Despite significant advances by Beaver and Clark (2008) and Coppock and Beaver (2013), our understanding of non-canonical exclusives has lagged behind. The present account shows that non-canonical exclusive flavors studied by Orenstein (2015), Wiegand (2016), and Beltrama (2018) can be unified by adopting potential questions as the mechanism for generating alternatives.

The account also proposes a distinction between strong and weak exclusion inspired by Wiegand and Beltrama. While a strong exclusive declares alternatives to be false, a weak exclusive declares them to be merely unassertable. This distinction parallels the distinction between primary and secondary implicatures in the literature on scalar implicatures and exhaustivity inferences (Sauerland, 2004), and we can build on insights from this literature to derive strong exclusion from weak exclusion.

Finally, *just* likely fits into a larger class of phenomena that manipulate possible future discourse developments through reference to a potential question. The claim that lexical items exist whose primary purpose it is to modify the future of discourse is a relatively new idea, though one which is advocated by Onea (2016) as well. It is undeniable that humans make plans about the future of a discourse, and also that disagreements and misunderstandings about these plans arise on a regular basis. Thus, it should not be surprising that natural languages include functional elements devoted to this kind of planning. Further exploration of other elements sensitive
to potential questions can deepen our understanding of the semantics-pragmatics interface and how language provides tools that help interlocutors shape discourse structure to suit their needs.

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Linking scope, exhaustivity and ignorance
Tharanga WEERASOORIYA — University of Ottawa/USJ

Abstract. This paper accounts for a link between scope and epistemic effects of - hari marked disjunctions/indefinites in Sinhala (Indo Aryan, Sri Lanka) with respect to DPs carrying universal quantificational force. It proposes to derive the wide/narrow scope and related epistemic effects as implicatures by way of exhaustification with respect to alternatives associated with a disjunction/indefinite. A doxastic and an exhaustivity operator placed in the syntactic structure of a - hari disjunction/indefinite construction serve in deriving the implicatures, following the grammatical approach to derivation of implicatures (cf. Fox, 2007; Chierchia et al., 2012; Meyer, 2013; Nicolae, 2017, a.m.o.).

Keywords: disjunction, indefinites, scope, exhaustivity, ignorance.

1. Introduction
A Sinhala (Indo-Aryan, Sri Lanka) disjunction/indefinite formed with the particle - hari can receive a wide or narrow scope (WS/NS) interpretation with respect to a universal quantifier of a DP as seen in (1). Crucially, different types of epistemic implicatures/inferences (EIs) are also generated relative to the differences in the scope configurations as shown in (1).²

(1) a. hæmə lamə-ek-mə Giita-hari Maala-hari hamuuna.
every student-INDF-EMP Giita-hari Maala-hari met
“Every student met Giita or Maala.”

b. hæmə lamə-ek-mə kaaw-hari hamuuna.
every student-INDF-EMP wh-hari met
“Every student met somebody.”

WS READING: Every student met either Giita or Maala/somebody (-hari/somebody > ∀).
EI: The speaker does not know who.

NS READING: Every student met at least one of Giita or Maala/somebody (∀ > -hari/somebody).
EI: The speaker may know who met who.

Thus, when the - hari disjunction/indefinite is interpreted with a wide scope effect with respect to the universal quantifier, it gives rise to ignorance implicatures. These ignorance implicatures can disappear when the disjunction/indefinite is interpreted with a narrow scope effect. Observations somewhat similar to those in (1) are found in Fox (2007) for English or disjunction, Alonso-Ovalle and Shimoyama (2014) for Japanese wh-ka indefinites, Nicolae (2017) for French ou disjunction and Alonso-Ovalle and Menéndez-Benito (2017) for Spanish algún indefinites. However, as discussed in Section 3, the previous accounts on independent grounds do not establish a clear link between wide/narrow scope effects of disjunction or indefinites and generation/obviation of ignorance inferences.

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2I use the terms implicatures and inferences interchangeably in this paper to mean the same.

This paper, drawing insights from previous accounts, claims that the relation between the scope and ignorance inferences can be accounted for based on the differences in the scope of an exhaustivity operator with respect to a doxastic operator assumed to take scope over a disjunction/indefinite sentence. This characterization, however, runs into a complication as a Fox defined exhaustivity operator (\(Exh\): cf. Fox, 2007) on a Sauerland defined set of alternatives (cf. Sauerland, 2004) falls short of deriving the exhaustivity implicatures akin to wide scope effects. It shows that a Fox defined \(Exh\) operating on a set including a subset of alternatives closed under conjunction can derive a strong exclusivity implicature akin to the wide scope effects (inspired by Spector, 2016). The paper is organized in the following manner. Section 2 offers descriptive facts pertaining to the formation of disjunctions and indefinites with the particle -hari. Section 3 discusses a sample of previous accounts and their implications for the proposal in this paper. Section 4 presents the proposal. Section 5 provides a summary and conclusion.

2. Disjunctions and indefinites with -hari in Sinhala

The particle -hari is used to form both disjunctions and indefinites in Sinhala. Following are some relevant descriptive facts of the formation of disjunctions/indefinites with the particle -hari.

2.1. Disjunctions with -hari

Disjunctions with -hari are formed with the particle -hari combining disjuncts (or individual alternatives) as shown in the example in (2).

\[
\text{(2) John Giita-hari Maala-hari hamu-un-a.} \\
\text{John Giita-hari Maala-hari meet-PAST-A} \\
\text{“John met Giita or Maala.”}
\]

Thus, the particle -hari attached to alternatives forms disjunctions in Sinhala.

2.2. Indefinites with and without -hari

Indefinites in Sinhala are formed as plain indefinites, wh-indefinites and complex indefinites as discussed in the following sections.

2.2.1. Plain indefinites (i.e. indefinites without -hari)

Plain indefinites in Sinhala are formed by adding the particle -ek/ak to a noun root as seen in the example in (3).

\[
\text{(3) John guruwəriy-ak bænda.} \\
\text{John teacher-INDF married} \\
\text{“John married a teacher.”}
\]

Plain indefinites are different from -hari indefinites as shown next.

\(^{3}\)Combining alternatives with the particle -hari is only one way to form disjunctions in colloquial Sinhala. Sinhala also makes use of the particle -dx to form disjunctions in a similar fashion in colloquial Sinhala. Formal Sinhala makes use of the item ho to form disjunctions. See Weerasooriya (2019) for more details. This paper only focuses on the disjunctions formed with the particle -hari and a discussion of other disjunctions under the scope of a universal quantifier is left for future research.
2.2.2. Indefinites with -hari

Indefinites similar to indefinite pronouns can be formed by adding the particle -hari to a wh-word (or indeterminate pronouns (IDPs): cf. Kuroda, 1965; Kratzer and Shimoyama, 2002) as shown in (4).

(4) John mon-wa-hari kan-w-a.
    John what-hari eat-A
    “John is eating something.”

Thus, indefinite pronouns make use of the particle -hari attached to wh-words (IDPs).

2.2.3. Complex indefinites with -hari

The particles -hari attached to wh-words can also be used with plain indefinites like kell-ek ‘a girl’ to form complex indefinites like kaaw-hari kell-ek ‘some girl’.

(5) John kaaw-hari kell-ek hamu-una.
    John who-hari girl-INDF meet-PAST
    “John met some girl.”

Thus, the particle -hari attached to IDPs can be combined with plain indefinites to form complex indefinites.

The particle -hari is also a positive polarity item (PPI). This is discussed next.

2.3. The particle -hari as a PPI

Disjunctions or indefinites formed with the particle -hari can not be interpreted under clause-mate (immediate scope of) negation as illustrated in (6).

(6) a. John Gita-hari Mala-hari dækk-e næ.
    John Gita-hari Mala-hari saw-E not
    “John did not see Gita or he did not see Mala. or > not
    (This would be true in a context where John saw exactly one of Gita or Mala, but
    he is not sure which one he did not see. Thus, not>or (i.e. John did not see any of
    them) is ruled out.)

b. John kaaw-hari dæk-k-e næ.
    John who-hari saw-E not
    “John did not see somebody.” somebody > not
    (This would be true in a context where John did see someone, but he did not see
    some particular one. Thus, not>someone (i.e. John did not see anyone) is ruled
    out.)

    John who-hari a-girl saw-E not
    “John did not see some girl.” some girl > not
    (This would be true in a context where John did see some girl, but he did not see

---

This paper focuses only on the indefinites marked with the particle -hari. Indefinites are also formed with the particle -do in the same manner. See Weerasooriya (2019) for more details. An analysis of indefinites formed with the particle -do is beyond the scope of this paper and is left for future research.
some particular girl. Thus, not > some girl (i.e. *John did not see any girl*) is ruled out.

Thus, -hari is a PPI. (This analysis was mainly motivated by the analysis of French *soit — soit* as a PPI in Spector, 2014).\(^5\)

The PP behavior of -hari is crucial in accounting for the wide scope effects and ignorance inferences as well as the differences with respect to the scope and ignorance effects as discussed in Section 4.

### 3. Implications from previous accounts

Scalar/scope and epistemic effects of disjunction/indefinites with respect to DPs with universal quantificational force have received much attention in the recent literature (Fox, 2007; Alonso-Ovalle and Shimoyama, 2014; Nicolae, 2017; Alonso-Ovalle and Menéndez-Benito, 2017). In the following, I review this sample of accounts to draw insights from some of the general implications associated with disjunction/indefinite scope cross-linguistically.

#### 3.1. Fox 2007

Fox (2007) shows that the disjunction *or* under a universal quantifier in English gives rise to scalar inferences as in (7).

\[(7) \text{Every friend of mine has a boyfriend or a girlfriend.}\]

Implicatures:

a. It is not true that every friend of mine has a boyfriend.

b. It is not true that every friend of mine has a girlfriend.

Fox accounts for such scalar and related ignorance inferences in (7) based on a Sauerland-defined set of alternatives and procedure (as conversational implicatures). For instance, Sauerland (2004) argues that the set of alternatives of a disjunction is formed of individual disjuncts as well as the conjunction, which can be represented as in (8).

\[(8) \text{Alt } (p \lor q) = \{ p \lor q, p, q, p \land q \}\]

Sauerland (2004) in his Neo-Gricean approach to implicature calculation employs a knowledge or belief operator which he dubs as \(\kappa\) to derive ignorance as well as scalar implicatures in terms of primary and secondary implicatures. Following Sauerland, Fox derives the scalar and related ignorance inferences as primary and secondary implicatures with a belief operator as in (9).

\[(9) \forall x (P(x)) \lor Q(x)) \]

**Primary Implicatures:** \(-B_s (\forall x P(x)), B_s (\forall x Q(x))\) (\(-B_s \forall x (P(x)) \land Q(x))\), follows)

**Secondary Implicatures:** \(B_s (\neg \forall x P(x)), B_s (\neg \forall x Q(x))\) (\(B_s \neg \forall x (P(x)) \land Q(x))\), follows)

However, Fox does not discuss the relationship between scope effects and ignorance inferences.

---

\(^5\)A reviewer asks whether there is a particular prosody/focus associated with -hari sentences in these negative contexts as English *or* serves to disambiguate scope when it is stressed. This does not hold for -hari. The PP character is a lexical property of -hari.
Neither does Fox discuss the implications associated with obviation of ignorance inferences. Fox’s (2007) primary interest is in deriving the free-choice implicatures of a disjunction in the scope of a possibility modal such as may as in the example in (10).

(10) You may eat the cake or the ice-cream.

Fox proposes to derive the free-choice effects of a construction as in (10) by recursive application of an exhaustivity operator (Exh) with the notion of innocent exclusion (IE) incorporated into the definition of Exh as in (11).

\[
\text{Exh}(A_{st,t})(p_{st})(w) \iff p(w) \land \forall q \in \text{I.E}(p,A) \rightarrow \neg q(w) \quad \text{(Fox 2007)}
\]

This amounts to the meaning that the proposition expressed by the sentence under its scope is true and all its innocently excludable competitors (alternatives) are false. Rather than claiming that a proposition \( p \) is true as opposed to all other alternatives, Fox (2007) proposes to identify the propositions that can be safely excluded which are referred to as “innocently excludable” propositions. As in Fox (2007), the definition of the set of innocently excludable competitors to a certain proposition \( p \) in a set of propositions \( A \) is represented in (12).

\[
\text{I.E}(p,A) = \cap \{A' \subseteq A: A' \text{ is a maximal set } A' \text{ s.t. } A' \neg \cup \{p\} \text{ is consistent} \}
\]

This amounts to the meaning that given a proposition \( p \) and a set of alternatives \( A \), innocent exclusion \( \text{I.E}(p,A) \) excludes any maximal set of propositions in \( A \) such that its exclusion is consistent with the prejacent.

The free-choice effects of (10) are derived by recursive application of \( \text{exh} \) operating on a Sauerland defined set of alternatives as in (13), where \( \Diamond \) represent epistemic possibility.

\[
\text{Exc}(C')(\text{Exh}(C')(\Diamond (p \lor q))) = \Diamond (p \lor q) \land \neg \Diamond (p \land q) \quad \text{and}
\]

\[
\neg (\Diamond p \land \neg \Diamond q) \quad \text{and}
\neg (\Diamond q \land \neg \Diamond p)
\]

\[
= \Diamond p \lor \Diamond q \quad \text{and}
\neg \Diamond (p \land q)
\]

The Fox defined \( \text{Exh} \) as in (11) with the notion of innocent exclusion rightly captures the free-choice effects of a construction as in (10). However, as discussed in Section 3.5, we run into complications when we try to derive the strong exclusivity inferences akin to wide scope effects by application of the \( \text{Exh} \) with the notion of innocent exclusion (cf also. Fox, 2007 and Spector, 2016). In Section 4, I propose that we can derive the desired effects if we include a set of alternatives closed under conjunction in a Sauerland defined set still in keeping with consistency.

A more recent account on indefinite scope and ignorance effects is found in Alonso-Ovalle and Shimoyama (2014). Implications of this account are discussed next.

3.2. Alonso-Ovalle and Shimoyama (2014)

Alonso-Ovalle and Shimoyama (2014) note that the Japanese \( \text{wh-}ka \) indefinites under a universal quantifier as in (14) gives rise to ignorance inferences when interpreted over the universal
quantifier. They also show that when the indefinite is interpreted within the scope of the quantifier, the ignorance effects disappear.

(14) Dono kyooju-mo dare-ka gakusee-to odotteru. which professor-MO who-KA student-with is.dancing
    “Every professor is dancing with some student.”

They account for the generation and obviation of such ignorance inferences as primary and secondary implicatures as in (15b) and (15c).

(15) a. □ [Every professor is dancing with s1 or s2 or s3]
    b. ¬ □ [Every professor is dancing with s1], ¬ □ [Every professor is dancing with s2], ¬ □ [Every professor is dancing with s3]
    c. □ ¬ [Every professor is dancing with s1], □ ¬ [Every professor is dancing with s2], □ ¬ [Every professor is dancing with s3]

However, the derivation in (15b) is equivalent to the following.

(16) ♦ ¬ [∀x s1(x)] ∧ ♦ ¬ [∀x s2(x)] ∧ ♦ ¬ [∀x s3(x)]

The LF in (16) amounts to the meaning that in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s1 and in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s2 and in some worlds epistemically accessible to the speaker it is false that every professor is dancing with s3. This rightly derives the predicted ignorance effects. However, it also gives rise to a distributivity/narrow scope effect. Thus, Alonso-Ovalle and Shimoyama (2014) do not establish a clear link between wide scope effects and ignorance inferences.

Nicolae (2017) has more recently proposed to derive ignorance inferences of a disjunction in a matrix context by way of a doxastic operator (cf. Alonso-Ovalle and Menéndez-Benito, 2010 and Alonso-Ovalle and Shimoyama, 2014) combined with an exhaustivity operator (cf. Fox, 2007). This is discussed next.

3.3. Nicolae (2017)

Nicolae (2017) derives ignorance inferences of the French disjunction ou as in (17) by way of exhaustification with respect to domain alternatives as shown in (18).

(17) Marie a parlé à Jean ou Paul.
    Mary talked with John or Paul.

(18) a. □ [p ∨ q]
    b. AltD (□ [p ∨ q]) = {□p, □q}

6Alonso-Ovalle and Shimoyama (2014) employ an epistemic necessity modal represented with □ in the sense of belief/knowledge operator as in Sauerland (2004) or Fox (2007) to derive the implicatures. Also see (24) for a definition of □.

7Nicolae (2017) marks a difference between scalar alternatives (i.e. conjunctive alternatives) and domain alternatives (i.e. individual alternatives) when deriving ignorance inferences. I follow the same approach in the derivations in this paper. I mark domain alternatives as AltD and scalar alternatives as AltS. For instance, see the derivation in (22).
c. \( \text{Exh}_D[\Box (p \lor q)] = \Box (p \lor q) \land \neg \Box p \land \neg \Box q \) 

Nicolae utilizes a doxastic operator as defined in Alonso-Ovalle and Menéndez-Benito (2010) and a slightly modified version of a Fox defined exhaustivity operator as in (19) to derive the implicatures.\(^8\)

(19) \( \text{Exh}(p) = p \land \forall q \in \text{IE } (p, \text{Alt}(p)) : \neg q \)

where: \( \text{IE } (p, \text{Alt}(p)) = \lambda q \in \text{Alt}(p). \neg \exists r \in \text{Alt}(p) : (p \land \neg q) \rightarrow r. \)

This amounts to the meaning that \( p \) is true and any alternative \( q \) not entailed by \( p \) is false, as long as negating \( q \) is consistent with negating any other non-weaker alternatives. (cf. Nicolae, 2017)

Nicolae (2017) does not discuss the ignorance inferences associated with disjunction in the nuclear scope position of a universal quantifier.\(^9\) However, the way the \( \text{Exh} \) operator is used to derive ignorance inferences in Nicolae (2017) is relevant for the derivations and discussion here.

More recently, Alonso-Ovalle and Menéndez-Benito (2017) propose to derive the ignorance inferences of Spanish \textit{algún} indefinites with respect to a universal quantifier as a quantity implicature by means of pragmatic competitors. This is discussed next.


Alonso-Ovalle and Menéndez-Benito (2017) note that when \textit{algún} in the example in (20) is interpreted with scope over the universal quantifier (i.e. in a context where every professor is dancing with the same student), it gives rise to an ignorance effect. They claim that when \textit{algún} is interpreted in the scope of the universal quantifier, (i.e. in a context where different professors are dancing with different students), the speaker can utter the sentence even if s/he knew well which professors were dancing with which students. Thus, the ignorance effect is shown to disappear when \textit{algún} is interpreted in the scope of the universal quantifier.

(20) Todos los profesores están bailando con algún estudiante.

All the professors are dancing with algún student

“Every professor is dancing with some student.”

Alonso-Ovalle and Menéndez-Benito (2017) refer to the above as co-variation contexts and argue that the presence and absence of ignorance inferences is a result of a quantity implicature. They claim that when the domain of students for \textit{algún} include the set \{ Juan, Lola, Sara \}, the pragmatic competitors will be as those in (21).

(21) Every professor is dancing with a student in \{ Juan, Lola, Sara \}

a. Every professor is dancing with a student in \{ Juan \}

b. Every professor is dancing with a student in \{ Lola \}

c. Every professor is dancing with a student in \{ Sara \}

They argue that the pragmatic competitors in (21) rule out a situation where the speaker can

\(^8\)Nicolae uses a slightly reformulated version of the Fox (2007) \( \text{Exh} \) still keeping to the spirit of the original version of \( \text{Exh} \) in Fox (2007) as in (11)

\(^9\)Nicolae (2017), however, discusses the implications associated with disjunction in the restrictor of a universal quantifier, which has no direct relevance to our discussion here.
commit to any of them. Then the ignorance effect is derived. They also argue that (21) is compatible with a context where different professors are dancing with different students and the speaker knows who is dancing with who, which is compatible with the narrow scope reading of disjunction with respect to the universal quantifier.

As we can see here, Alonso-Ovalle and Menéndez-Benito (2017) derive the ignorance inferences via a pragmatic competition between a proposition and alternative stronger propositions to that proposition. However, this proposal also does not account for a link between scope and epistemic effects.

It is clear that the previous analyses on independent grounds have not accounted for a link between scope and epistemic effects. In the next section, I show that when we attempt to derive the exclusivity inferences akin to wide scope effects with the existing accounts without further assumptions, we are faced with complications.

3.5. Complications for deriving wide scope effects

The meaning that a -hari disjunction, when interpreted over a universal quantifier, gives rise to is that in all the world epistemically accessible to the speaker either all the students met Giita or they met Maala, thus a meaning akin to a wide scope effect. However, a Fox defined Exh (cf. Fox, 2007) operating on a Sauerland-defined set of alternatives (cf. Sauerland, 2004) in Nicolae’s (2017) procedure gives rise to a distributivity effect as explained in the following with respect to the derivation in (22). This poses a problem for deriving the exclusivity implicature akin to a wide scope effect.

(22) a. □ [hæmə lamɔy-ek-mə Giita-hari Maala-hari hambɔ-un-a.
   “ Every student met Giita or Maala.”

b. Assertion: □ [ ∀x (G(x) ∨ M(x))]

c. Domain Implicatures: AltD (□ [ ∀x (G(x) ∨ M(x))]) = { □ ∀xG(x), □ ∀xM(x) }
   ExhD ( □ [ ∀x (G(x) ∨ M(x))]) = □ [ ∀x (G(x) ∨ M(x)) ∧ ¬ □ [ ∀x G(x)] ∧ ¬ □ [ ∀x M(x) ]

d. Scalar Implicature: AltS ( ∀x (G(x) ∨ M(x)) ) = { ∀x (G(x) ∧ M(x)) }
   ExhS ( ∀x (G(x) ∨ M(x)) ) = ∀x (G(x) ∨ M(x)) ∧ ¬ ( ∀x (G(x) ∧ M(x)) )

e. Total meaning: □ [ ∀x (G(x) ∨ M(x))] ∧ ¬ □ [ ∀x G(x)] ∧ ¬ □ [ ∀x M(x)] ∧ □ ¬ [ ∀x (G(x) ∧ M(x))]

In (22a), we have the -hari disjunction sentence with the universal quantifier and the covert doxastic operator is adjoined at the matrix level at LF. Assertion of (22a) is represented in (22b) (i.e. that the speaker believes/knows that all the students met Giita or Maala). The domain implicatures drawn by exhaustification with respect to epistemic domain alternatives result in the uncertainty implicatures as represented in (22c). This serves to generate the ignorance component of meaning as uncertainty implicatures, that the speaker does not believe/know that all the students met Giita and the speaker does not believe/know that all the students met Maala. The scalar implicature is derived by exhaustification with respect to the scalar alternative as seen in (22d). This adds to the meaning that the speaker believes/knows that it is false that all the
students met Giita and Maala.\textsuperscript{10} In (22e), we have the total meaning derived by the union of the domain and scalar implicatures.

The derivation in (22e) is equivalent to the following, which shows that it can give rise to a distributivity effect.\textsuperscript{11}

\begin{equation}
\Box [\forall x (G(x) \lor M(x))] \land \Diamond \neg [\forall x G(x)] \land \Diamond \neg [\forall x M(x)] \land \Box \neg [\forall x (G(x) \land M(x))]
\end{equation}

This in other words means that in all of the speaker’s epistemically accessible worlds every student met Giita or Maala and in some of the speaker’s epistemically accessible worlds it is false that every student met Giita and in some of the speaker’s epistemically accessible worlds it is false that every student met Maala and in all of the speaker’s epistemically accessible worlds it is false that every student met Giita and Maala.

Thus, a Fox-Sauerland inspired $Exh$ falls short of deriving the wide scope effects of disjunction with respect to the universal quantifier.

In this background, I present a proposal based on the scope of the $Exh$ operator with respect to the doxastic operator and characterization of the alternatives to account for the relationship between wide/narrow scope effects and generation/obviation of ignorance inferences.

4. The proposal

I argue that the wide scope effects and related ignorance inferences can be derived with the $Exh$ operator taking scope over a doxastic operator with respect to domain alternatives and operating on a subset of alternatives closed under conjunction with respect to scalar alternatives.

I show that the narrow scope and obviation of ignorance effects can be accounted for by way of the $Exh$ operator scoping below the doxastic operator with respect to domain alternatives and operating on a regular Sauerland defined set of alternatives. In the following, I lay out the details and derivations of the proposal. I begin by introducing the theoretical background, tools and assumptions associated with the derivations and claims in the proposal.

4.1. Theoretical background, tools and assumptions

I assume that a covert assertoric/doxastic operator akin to an epistemic necessity modal adjoined at the matrix level at LF scopes above a disjunction/indefinite construction (cf. Alonso Ovalle and Menénde Benito, 2010; Meyer, 2013; Alonso Ovalle and Shimoyama, 2010 and Nicolae, 2017). I adopt a doxastic operator as defined in Alonso-Ovalle and Menéndez-Benito (2010) as in (24) and represent this with $\Box$ in the derivations.

\begin{equation}
[[\text{ASSERT}]]^c = \lambda p. \lambda w. \forall w': \text{Epistemic}_{\text{Speaker of } c}(w) [ p (w') ]
\end{equation}

This amounts to the meaning that the assertoric operator takes, as its arguments, a proposition

\textsuperscript{10}Note that the scalar exhaustion happens below the doxastic operator to give rise to an exclusivity implication.

\textsuperscript{11}The LF in (23) can also be represented as $\Box [\forall x (G(x) \lor M(x))] \land \Diamond \exists x \neg G(x) \land \Diamond \exists x \neg M(x) \land \Box \exists x \neg (G(x) \land M(x))$, which makes the distributivity effect more transparent.
p, a world $w$ and asserts that this proposition is true in all worlds $w'$ epistemically accessible to the speaker in $w$. The assertoric operator serves in accounting for the scope effects as well as deriving ignorance inferences.

Inspired by Spector (2014), I assume that given its PP character, -hari associates with an implicit exhaustivity operator ($O_{E,hr}$) placed in the syntactic structure of a disjunction/indefinite construction (cf also: Weerasooriya, 2018). I also assume that exhaustification is partially determined by the semantics of the particle -hari carrying an uninterpretable exhaustivity [$unExh$] feature to be matched with the interpretable exhaustivity [$inExh$] feature of the $O_{E,hr}$. Thus, I follow a hybrid system of lexical (cf. Levinson, 2000; Chierchia, 2004, a.m.o.) and grammatical (cf. Fox, 2007 and Chierchia et al., 2012) approaches in the derivation of implicatures. I adopt the Fox defined $Exh$ as presented in (11) in the derivations. This serves in generating the exhaustivity implicatures of the alternatives associated with a disjunction/indefinite.

Inspired by Spector (2016), I assume that a set of alternatives can include a subset of alternatives to derive the strongest meaning. Comparing exhaustivity operators, Spector (2016) claims that an $Exh$ incorporating innocent exclusion (i.e. Fox defined $Exh$, which Spector, 2016 abbreviates as $Exh_{ie}$) and an $Exh$ based on minimal worlds/models (which Spector, 2016 abbreviates as $Exh_{mw}$) operating on a set of alternatives derive the same results when alternatives are closed under conjunction. He also notes that the two operators may deliver different results when disjunctions are embedded under other operators. Following Fox (2007), Spector notes that $Exh_{ie}$ operating on a Sauerland defined set of alternatives: $\{\Box (A \lor B), \Box A, \Box B, \Box (A \land B)\}$ will return the proposition: $\Box (A \lor B) \land \neg \Box (A \land B)$ which is compatible with the proposition $\Box A \land \Box B$. Spector also notes that $Exh_{mw}$ delivers different results: $\Box (A \lor B) \land \neg (\Box A \land \Box B)$, which is obviously stronger. Spector also notes that in a Sauerland defined set of alternatives (i.e. $\{\Box (A \lor B), \Box A, \Box B, \Box (A \land B)\}$), the alternative $\Box (A \land B)$ is equivalent to the alternative $\Box A \land \Box B$ which is closed under conjunction. Inspired by Spector (2016), I assume that the set of alternatives in the wide scope reading includes alternatives closed under conjunction.

With this background and tools and assumptions in hand, I begin by accounting for the wide scope effects and ignorance inferences of -hari disjunctions in the scope of a universal quantifier in the next section.

4.2. Deriving the wide scope effects and ignorance inferences

In Section 3.5, we saw that a Fox defined $exh$ operating on a Sauerland defined set of alternatives is not able to rightly capture the exclusivity inferences akin to wide scope effects. In

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12I maintain this assumption implicitly in all the derivations in this paper. A discussion and representation of this approach with the syntactic diagrams are beyond the scope of this paper. See Weerasooriya (2019) for a detailed account of this approach. Owing to this limitation in the body of the paper, in the abstract and introduction, I opted to say that I mainly follow the grammatical approach to derivation of implicatures.

13The reader is referred to Spector (2016) for a discussion of different formulations of Exh. As Spector discusses (as Fox, 2007 also notes), closing alternatives under conjunction blocks free-choice effects. This needs to be considered.
this section, I propose to derive these effects by including alternatives closed under conjunction in a Sauerland defined set of alternatives. Note that alternatives closed under conjunction will include the set of alternatives in (25).

\[
\{ \forall x \ G(x) \land \forall x \ M(x) \}
\]

Fox (2007) (following a conversation with Gennaro Chierchia) notes that \(Alt (\forall x (P(x) \lor Q(x)))\) contains additional members: \(\exists x (P(x) \lor Q(x)), \exists x (P(x)), \exists x (G(x))\). Now, observe the entailment patterns in (26).

\[
\begin{align*}
\forall x (G(x) \land M(x)) & \to \exists x (G(x) \land M(x)) \\
\forall x G(x) \land \forall x M(x) & \to \exists x G(x) \land \exists x M(x)
\end{align*}
\]

When alternatives are closed under conjunction, the set of \(Alt (\forall x (G(x) \lor M(x)))\) will include:

\[
\{ \forall x G(x) \land \forall x M(x), \exists x G(x) \land \exists x M(x) \}
\]

The negation of the alternative: \(\exists x G(x) \land \exists x M(x)\) gives rise to a stronger inference than the negation of the alternative: \(\forall x G(x) \land \forall x M(x)\). The strongest meaning (wide scope effect) could be derived by negation (exhaustivity) applied to \(\exists x G(x) \land \exists x M(x)\) as seen in (28d). Matrix exhaustification (i.e. \(Exh\) operator scoping above the doxastic operator) with respect to domain alternatives derives the ignorance inferences related to wide scope as shown in (28c) (cf also: Nicolae, 2017 as in (18)).

\[
\begin{align*}
\Box [\text{hæmə lama-ek-ma Giita-hari Maala-hari hambə-un-a.}] & \quad \text{“Every student met Giita or Maala.”} \\
\text{b. Assertion: } \Box [\forall x (G(x) \lor M(x))] & \\
\text{c. Domain Implicatures: } Alt_D(\Box [\forall x (G(x) \lor M(x))]) = \{ \Box \forall x G(x), \Box \forall x M(x) \} \\
Exh_D (\Box [\forall x (G(x) \lor M(x))]) & = \Box [\forall x (G(x) \lor M(x))] \land \neg \Box [\forall x G(x) \land \neg \Box [\forall x M(x)]] \\
\text{d. Scalar Implicatures: } Alt_S(\forall x (G(x) \lor M(x))) = \{ \forall x (G(x) \land M(x)), \exists x G(x) \land \exists x M(x) \} \\
Exh_S (\forall x (G(x) \lor M(x))) & = \forall x (G(x) \land M(x)) \land \neg (\exists x G(x) \land \exists x M(x)) \\
\text{e. Total meaning: } = \Box [\forall x (G(x) \lor M(x))] \land \neg \Box [\forall x G(x) \land \neg \Box [\forall x M(x)] \land \neg \Box [\exists x G(x) \land \exists x M(x)]
\end{align*}
\]

So, the result of applying the \(Exh\) as in Fox (2007) with a set of alternatives closed under conjunction is that it returns an exclusivity implicature which is stronger than that in (22e). The LF as derived in (28e) accounts for the wide scope effects of disjunction as depicted in the situation in (29). In (29), we have two worlds W1 and W2 epistemically accessible to the speaker in W0. In W1, the proposition that all the boys met Giita is true and the proposition that all the boys met Maala is false. In W2, the proposition that all the boys met Maala is true and the proposition that all the boys met Giita is false. The LF as derived in (28e) is only felicitous in a context similar to one in (29) (crucially not similar to one in (30)), where it amounts to the meaning that in all the world epistemically accessible to the speaker either all the students met Giita or they met Maala, thus a meaning akin to a wide scope effect.
This way, I speculate that a Fox defined \textit{Exh} operating on a Sauerland inspired set of alternatives including a subset of alternatives closed under conjunction can derive both the wide scope and ignorance effects of a -\textit{hari} disjunction with respect to a universal quantifier.

In the next section, I show that exhaustification below the doxastic operator is responsible for obviation of ignorance inferences.

4.3. Accounting for the narrow scope effects and obviation of ignorance inferences

Local exhaustification (i.e. \textit{Exh} operator scoping below the doxastic operator) with respect to both domain and scalar alternatives serves to account for both narrow scope effects and obviation of ignorance inferences as illustrated in (31) and the explanation that follows it.

(31)  a. $\Box [\text{hēmɔ goolɔ-ek-mɔ Giita-hari Maala-hari hambɔ-un-a.}]$
        “Every student met Giita or Maala.”
    b. Assertion: $\Box[\forall x (G(x) \lor M(x))]$
    c. Domain Implicatures: $\text{Alt}_D(\forall x (G(x) \lor M(x))) = \{ \forall x G(x), \forall x M(x) \}$
        $\text{Exh}_D (\forall x (G(x) \lor M(x))) = \forall x (G(x) \lor M(x)) \land \neg \forall x G(x) \land \neg \forall x M(x)$
    d. Scalar Implicature: $\text{Alt}_S (\forall x (G(x) \lor M(x))) = \{ \forall x (G(x) \land M(x)) \}$
        $\text{Exh}_S (\forall x (G(x) \lor M(x))) = \forall x (G(x) \lor M(x)) \land \neg \forall x (G(x) \land M(x))$
    e. Total meaning: $\Box [\forall x [G(x) \lor M(x)]] \land \Box \neg \forall x G(x) \land \Box \neg \forall x M(x) \land \Box \neg \forall x [G(x) \land M(x)]$

In (31a), we have the -\textit{hari} disjunction sentence with the universal quantifier with the covert doxastic operator adjoined at the matrix level at LF. Assertion of (31a) is represented in (31b). The domain implicatures are drawn by exhaustification with respect to non-modalized domain alternatives (i.e. \textit{Exh} operator scoping below the doxastic operator) as represented in (31c). This serves to generate the narrow scope effect of meaning as a distribution effect, that some students did not meet with Giita and some students did not meet with Maala. The scalar exhaustification also occurs below the doxastic operator as shown in (31d). In (31e), the union of the domain and scalar implicatures results in a derivation compatible with a meaning that all the students met at least one of the two individuals and the speaker knows who met whom.

Note that the derivation in (31e) is equivalent to the following.

(32) $\Box [\forall x (G(x) \lor M(x))] \land \Box \exists x \neg G(x) \land \Box \exists x \neg M(x) \land \Box \exists x \neg [G(x) \land M(x)]$
The LF derived in (31e) is also compatible with (33).

(33) \[ \square [\forall x (G(x) \lor M(x))] \land \square \exists x M(x) \land \square \exists x G(x) \]

In other words,

(34) In all of the speaker’s doxastically accessible worlds every student met Giita or Maala and in all of the speaker’s doxastically accessible worlds some students met Maala and in all of the speaker’s doxastically accessible worlds some students met Giita.

Thus, the meaning of a -hari disjunction as derived in (31e) is compatible with a narrow scope reading of disjunction with respect to the universal quantifier and with a reading where the speaker knows who met who. For instance, the LF as derived in (31e) is compatible with any of the situations depicted in (35) or (36). In (35) and (36), we have the worlds W1, W2 and W3 epistemically accessible to the speaker from W0. In (35), in all the worlds epistemically accessible to the speaker, the proposition: John met Giita is true, and the proposition: John met Maala is false. This shows that the speaker knows that John met Giita and not Maala. (35) also shows that the speaker knows that Mary met Giita and not Maala and Tom met Maala not Giita. In (36), in all the worlds epistemically accessible to the speaker, the proposition: John met Giita is true, and the proposition: John met Maala is false. This shows that the speaker knows that John met Giita and not Maala. (36) also shows that the speaker knows that Mary met both Giita and Maala and Tom met Maala not Giita.

Thus, the LF in (31e) is compatible with any of the situations depicted in (35) and (36) which are situations where the speaker knows who met who.

This way, I account for the derivation of both the narrow scope reading and obviation of ignorance effects of a -hari disjunction under a universal quantifier based on exhaustification with respect to both domain and scalar alternatives below the doxastic operator.

The derivations in (28) and (31) are modeled on disjunctions with -hari. In the next section, I propose to extend the same analysis to indefinites with the assumption that the general function of indefinites is to introduce alternatives (building on Kratzer and Shimoyama, 2002).
4.4. Extensions to the domain of indefinites

Kratzer and Shimoyama (2002) argue that, like focus (cf. Rooth, 1985), indefinites too introduce sets of alternatives. They argue that indefinite pronouns denote sets of individuals as individual alternatives, rather than as properties. Thus, building on Kratzer and Shimoyama (2002), for the derivations involving indefinites, I assume that -hari indefinites introduce contextually relevant alternatives and the Exh operator and the sets of alternatives work in the same manner. Suppose that the domain of the indefinite in (1b) includes the alternatives Gita, Mala and Sita. The wide scope effects and related ignorance inferences are derived as in (37).

\[(37)\]

\[\square [\text{hæmø lamø-ek-mø kaawø-hari hambo-un-a.}] \]

“Every student met somebody.”

b. Assertion: \[\square \forall x \ (G(x) \lor M(x) \lor S(x))\]

c. Domain Implicatures: \[Alt_D (\square (\forall x \ (G(x) \lor M(x) \lor S(x)))) = \{ \forall x G(x), \forall x M(x), \forall x S(x) \}\]

Exh \[\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \neg \forall x \ M(x) \land \neg \forall x \ S(x)\]

d. Scalar Implicatures: \[Alt_S (\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \forall x \ M(x) \land \forall x \ S(x)\]

e. Total meaning: \[\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \forall x \ M(x) \land \forall x \ S(x)\]

Thus, as in the case of disjunction, the Exh operator scoping over the doxastic operator with respect to domain alternatives and operating on a subset of alternatives closed under conjunction with respect to scalar alternatives derives the predicted wide scope and ignorance effects.

I propose to derive the narrow scope effects and obviation of ignorance inferences of a -hari indefinite under a universal quantifier as in (38).

\[(38)\]

\[\square [\text{hæmø lamø-ek-mø kaawø-hari hambo-un-a.}] \]

“Every student met somebody.”

b. Assertion: \[\square [\forall x \ (G(x) \lor M(x) \lor S(x))\]

c. Domain Implicatures: \[Alt_D (\forall x \ (G(x) \lor M(x) \lor S(x))) = \{ \forall x G(x), \forall x M(x), \forall x S(x) \}\]

Exh \[\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \forall x \ M(x) \land \forall x \ S(x)\]

d. Scalar Implicatures: \[Alt_S (\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \forall x \ M(x) \land \forall x \ S(x)\]

e. Total meaning: \[\forall x \ (G(x) \lor M(x) \lor S(x))) = \forall x \ (G(x) \lor M(x) \lor S(x))) \land \neg \forall x \ G(x) \land \forall x \ M(x) \land \forall x \ S(x)\]
\[\land S(x) \land \Box \neg \forall x \{G(x) \land M(x) \land S(x)\}\]

Again, as in the case of disjunction, the \textit{Exh} operator scoping below the doxastic operator and operating on a regular Sauerland defined set of alternatives accounts for the predicted narrow scope and obviation of ignorance effects.

5. Summary and conclusion

This paper made a proposal to account for a link between wide/narrow scope effects and the related epistemic effects of -\textit{hari} disjunctions/indefinites with respect to DPs with universal quantificational force in Sinhala. It argued that both the relative scope of the \textit{Exh} operator with respect to a doxastic operator and the way alternatives are characterized are crucial in accounting for the related scope and epistemic effects. It also proposed to extend the application of exhaustivity based approaches (i.e. grammaticalized implicatures: cf. Chierchia et al., 2012) that were mostly limited to the domain of disjunction to the domain of indefinites to address certain issues still in debate in that domain. It also derived wide scope effects without manipulating syntactic scope, which is important for a novel analysis of wide scope disjunctions/indefinites.

References


Not all gradable adjectives are vague – Experimental evidence from adults and children
Merle WEICKER — Goethe University Frankfurt
Petra SCHULZ — Goethe University Frankfurt

Abstract. This paper investigates whether absolute gradable adjectives such as clean show characteristics of vagueness, as do relative gradable adjectives such as big. We addressed this question by examining adults’ interpretation of the antonyms clean and dirty in a picture-selection task. Children between the ages of 3 and 5 were tested with the same task to see how early the interpretation pattern shown by the adults emerges in the course of acquisition. Our findings indicate that absolute gradable adjectives do not show characteristics of vagueness in either the adults or the children. Absolute gradable adjectives are interpreted as having a minimum or maximum standard of comparison, which is not context-sensitive, and they do not give rise to borderline cases.

Keywords: gradable adjective, vagueness, context-sensitivity, standard of comparison, borderline case.

1. Introduction

According to Kennedy (2007), a sentence such as (1) is vague because it has the following three characteristics: (i) contextually variable truth conditions, (ii) the existence of ‘borderline cases’, and (iii) trigger of the Sorites Paradox.

(1) The cake is big.

It is widely agreed that the gradable adjective big is responsible for the uncertain interpretation of the sentence in (1). This interpretive uncertainty results from the observation that the interpretation of big is sensitive to the context (i). The sentence in (1) may be true in the context of cakes that a specific person, let’s say, Merle, usually bakes, but false in the context of wedding cakes offered in a catalogue. The interpretive uncertainty of (1) also results from the existence of borderline cases (ii). These are entities, for which it is difficult to judge whether the sentence in (1) is true or false. Imagine a cake buffet at a birthday party. A cupcake would clearly not be judged big, a Black Forest cake would clearly be called big, but for a middle-sized cheesecake it would be more difficult to judge it as big or not big. It constitutes a so-called ‘borderline case’ for which it is unclear whether the predicate is big is true or false. Finally, vague predicates have been shown to give rise to the Sorites Paradox (iii), which is illustrated in (2). Although the two premises P1 and P2 seem true, the conclusion C is false.

(2) P1. A 1-meter cake is big.

Kennedy (2007) argues that not all gradable adjectives show characteristics of vagueness: so-called absolute gradable adjectives (e.g., full, dirty) pattern differently from so-called relative gradable adjectives as big in (1). Other approaches, however, postulate a less sharp distinction between relative and absolute gradable adjectives (Burnett, 2012; Toledo and Sassoon, 2011).

The aim of the present study is therefore to examine whether adults treat absolute gradable adjectives as vague predicates, parallel to what has been found for relative gradable adjectives. By also testing children between the ages of 3 and 5, we examine how early the interpretation pattern shown by the adults emerges in the course of acquisition. The paper is organized as follows: the three characteristics of vagueness are explained in detail in Section 2 in the context of relative and absolute gradable adjectives. Previous empirical studies regarding adults’ and children’s interpretation of gradable adjectives are summarized in Section 3. Our study on the interpretation of absolute gradable adjectives in German is presented in Section 4. In Section 5, we discuss our findings.

2. Gradable adjectives and vagueness

2.1. Context-sensitivity

Gradable adjectives must be interpreted relative to a standard of comparison in order to evaluate whether the property introduced by the adjective holds of an individual. How this standard of comparison is determined differs between relative gradable adjectives (e.g., big, tall, long) and absolute gradable adjectives (e.g., full, dirty, straight): for relative gradable adjectives, the standard is contextually defined, whereas the standard for absolute gradable adjectives is less context-sensitive.

This analysis of gradable adjectives can be implemented in a degree-based framework. It is widely assumed that gradable adjectives denote relations between entities and degrees (Cresswell, 1976; von Stechow, 1984; Kennedy, 2007, among others). Degrees are understood as representations of measurement. A set of degrees that is totally ordered with respect to some dimension (e.g., height) is called a scale. Kennedy and McNally (2005) argue that gradable adjectives can differ regarding their scale structure. Adjectives can be associated with (i) totally closed scales, which have a minimal and a maximal endpoint (e.g., full, empty), with (ii) partially closed scales, which have either a minimal or a maximal endpoint (e.g., clean, dirty; dangerous, safe) or with (iii) totally open scales, which lack a minimal and a maximal endpoint (e.g., big, small). These differences in scale structure affect the interpretation of gradable adjectives. For gradable adjectives with open scales (referred to as relative gradable adjectives), the standard is context-dependent. In contrast, for gradable adjectives with (partially) closed scales (referred to as absolute gradable adjectives), the standard is less context-dependent: as a default, the standard corresponds to the minimal or maximal endpoint of the scale. Consequently, the adjective’s argument must show either a maximal degree of the property (e.g., clean, straight) or a non-zero degree of the property (e.g., dirty, bent). Therefore, the
examples in (3) are contradictory (marked as #) with absolute gradable adjectives ((3a) and (3b)) but not with relative gradable adjectives ((3c) and (3d)) (Kennedy, 2007, p. 26).

(3)  
a. # The rod is not bent, though there is a small bend in the middle.    
b. # The line is STRAIGHT, but you can make it straighter.\(^2\)    
c. Sam is not tall, but his height is normal for his age.    
d. That film is interesting, but it could be more interesting.

The difference between relative and absolute gradable adjectives regarding context-sensitivity is also mirrored by the relation of antonyms exemplified in (4). For relative gradable antonyms, the negation of one form does not entail the assertion of the other, that is, they are ‘non-complementary’ antonymous adjectives (Cruse, 1986).

(4) The cake is not small. \(\not\Rightarrow\) The cake is big.

Because the standard for relative gradable adjectives is context-dependent, the standard for big and small need not be the same degree (Kennedy, 2007; Kennedy and McNally, 2005). Therefore, an entity may exceed the standard for smallness without meeting the standard for bigness. Unlike relative gradable adjectives, absolute gradable adjectives license the inference ‘not ADJECTIVE \(\Rightarrow\) antonym of ADJECTIVE’, as illustrated in (5); hence they are ‘complementary’ antonymous adjectives.

(5) The plate is not dirty. \(\Rightarrow\) The plate is clean.

According to Kennedy (2007), this follows because dirty imposes a minimum standard and clean imposes a maximum standard. Consequently, an entity without a minimal degree of dirtiness has a maximal degree of cleanliness.

Note that there are exceptions to the generalization that adjectives with closed scales have absolute standards that are the scales’ minimal or maximal endpoint (Kennedy, 2007; Kennedy and McNally, 2005). These have led to the proposal of alternative approaches. Toledo and Sassoon (2011) argue that absolute gradable adjectives are interpreted relative to the context, just like relative gradable adjectives: the standard for clean, for instance, is lower for kitchen knives than for surgical instruments and the standard for dirty is lower for a child’s shirt than for a tuxedo. Using the maximum absolute gradable adjective full, McNally (2011) further shows that its standard need not be the maximal degree, for instance if wine glasses are considered. Example (6) by Rotstein and Winter (2004) shows that absolute gradable antonyms need not always be complementary. There seems to be a degree of dirtiness for which both clean and dirty would be judged false.

(6) This glass is almost dirty. It is certainly not clean, since it has some small spots on it, but it is not really dirty, and I am willing to drink from it if you insist.

\(^2\) The capitals signal focal stress, which forces a precise interpretation of the maximum gradable adjective. According to Kennedy (2007), this precise interpretation is necessary for this kind of entailment.
2.2. Borderline cases

Besides differences regarding context-sensitivity, the distinction between absolute and relative
gradable adjectives is reflected in the existence/absence of borderline cases. Example (7) (taken
from Kennedy, 2007, p. 24) is unnatural because the rod in question constitutes a borderline
case: for this rod it is unclear whether the predicate *is long* applies.

(7) ??We need a long rod for the antenna, but since long means ‘greater than 10 meters’ and
this one is 1 millimeters short of 10 meters, unfortunately, it won’t work.

In contrast, borderline cases do not exist for absolute gradable adjectives as the felicity of (8)
illustrates (taken from Kennedy, 2007, p. 25).

(8) The rod for the antenna needs to be straight, but this one has a 1 mm bend in the middle,
so unfortunately it won’t work.

Burnett (2012) calls the non-existence of borderline cases for absolute gradable adjectives into
question, however. According to Burnett, absolute gradable adjectives such as *bald* have
borderline cases: in addition to clear cases for bald and non-bald people, there may be less clear
borderline cases as for instance people with a quarter head of hair.

2.3. Sorites Paradox

As shown in (2), relative gradable adjectives give rise to the Sorites Paradox: although the two
premises are judged as true, the conclusion is false. Absolute gradable adjectives, in contrast,
do not give rise to a paradoxical conclusion because the second premise is judged as false. This
is illustrated in (9): P1 is true and P2 is false, hence the conclusion should be false. This is
indeed the case.

(9) P1. A plate without any spot of dirt is clean.
  P2. A plate with one spot of dirt is clean.
  C. A plate with very many spots of dirt is clean.

Again, it has been noted that this generalization may not hold for all absolute gradable
adjectives. Once more, the adjective *bald* is a case in point, as exemplified in (10). It is
questionable whether adding one hair to a bald person’s head turns the person from bald to not
bald; hence it is unclear whether the second premise is judged to be false. Therefore, the
conclusion is paradoxical, similar to the example with the relative gradable adjective *big* (see
element (2)).

(10) P1. A person without any hair is bald.
  P2. A person with one hair is bald.
  C. A person with a head full of hair is bald.

2.4. Summary
Theoretical accounts of the semantics of gradable adjectives largely agree that relative gradable and absolute gradable adjectives exhibit a number of differences. Relative gradable adjectives show three central characteristics of vagueness: the interpretation of relative gradable adjectives is always context-sensitive, there is no context such that borderline cases disappear, and relative gradable adjectives always give rise to the Sorites Paradox. Absolute gradable adjectives show no characteristics of vagueness. However, as we saw in the preceding sections in some cases characteristics of vagueness are present in absolute gradable adjectives as well. Different proposals have been suggested to account for the differences and similarities between relative and absolute gradable adjectives. The approach by Kennedy (2007, see also Kennedy and McNally, 2005), for instance, assumes that the apparent similarities between relative and absolute gradable adjectives regarding the characteristics of vagueness in fact result from different phenomena. According to this analysis, vagueness (i.e., context-sensitivity, borderline cases, and the presence of the Sorites Paradox) is part of the semantics of relative gradable adjectives but not of absolute gradable adjectives. Absolute gradable adjectives can have imprecise uses, which is a pragmatic phenomenon, but they are not vague. That is, speakers can tolerate some deviation from the minimum or maximum standard in some contexts. An alternative approach by Burnett (2012) suggests that two characteristics of vagueness—borderline cases and the Sorites Paradox—arise through pragmatic processes that are the same for all gradable adjectives. The differences regarding context-sensitivity are assumed to be part of the semantics of relative and absolute gradable adjectives. In summary, whereas relative gradable adjectives are commonly characterized as vague predicates, the nature of absolute gradable adjectives is still debated. In particular, it is open whether—in line with relative gradable adjectives—they should be analyzed as (potentially) vague predicates. If vagueness is part of the semantics of relative but not of absolute gradable adjectives, participants’ default interpretation in experimental settings should reflect the characteristics of vagueness for relative gradable but not for absolute gradable adjectives. Alternatively, if vagueness arises through pragmatic processes that are the same for relative and absolute gradable adjectives, participants’ readiness for a vague interpretation should be similar for relative and absolute gradable adjectives given the appropriate context.

Acquisition data may help to shed light on the similarities and differences between different types of gradable adjectives. In our view, there are two basic alternative theoretical approaches: one could assume two different underlying meanings for relative and absolute gradable adjectives, which may result from different scale structures. In this case, children need to discover that absolute gradable adjectives, which have a precise meaning, can also be used imprecisely. Alternatively, relative and absolute gradable adjectives could be assumed to share the same—potentially vague—meaning. In this case, children need to discover that absolute but not relative gradable adjectives can also be used precisely. By looking at children’s interpretation of gradable adjectives across different ages we can learn which interpretation learners choose initially. This in turn can help us to address the question of which of the two theoretical assumptions may be on the right track. If learners initially permit absolute gradable adjectives to have an imprecise reading, this finding would support the approach that all gradable adjectives are potentially vague. However, if learners initially do not permit absolute gradable adjectives to have an imprecise reading, this finding would support the view that absolute and relative gradable adjectives have different underlying meanings.
In what follows, we summarize the empirical findings of previous adult and child studies on the interpretation of gradable adjectives regarding context-sensitivity and borderline cases.

3. Empirical findings on the interpretation of gradable adjectives by adults and children

Let us first turn to the findings regarding the interpretation of relative gradable adjectives. Previous studies on adults’ and children’s interpretation of relative gradable adjectives support a semantic analysis as vague predicates. Findings by Syrett, Bradley, Kennedy and Lidz (2006) show that, just like adults, English-speaking children as young as age 3 are able to shift the standard of comparison for *big* and *long* depending on the context (see also Ebeling and Gelman, 1994; Sera and Smith, 1987; Syrett, Kennedy and Lidz, 2010). Moreover, by age 3, children locate the standard around the center of the corresponding scale (Syrett et al., 2006, for English; Foppolo and Panzeri, 2013, for Italian). Findings by Barner and Snedeker (2008) indicate that 4-year-old children interpret the antonyms *tall* and *short* as non-complementary. These findings all suggest a context-sensitive interpretation of relative gradable adjectives.

Concerning the existence of borderline cases, it has been shown for adults that for some objects the predicate *is big* is judged as neither clearly true nor clearly false (Alxatib and Pelletier, 2011; Égré and Zehr, 2018; Solt and Gotzner, 2010). Findings by Weicker and Schulz (2020 ) indicate that this sensitivity to borderline cases emerges already as early as age 3.

Let us now turn to studies on the interpretation of absolute gradable adjectives, where theoretical approaches disagree on whether they should be analyzed as vague predicates (see Section 2). Syrett et al. (2006) and Syrett et al. (2010) used a ‘Presupposition Assessment Task’ to investigate whether participants shift the standard of comparison for *spotted, full, straight* and *bumpy* depending on the context. In this task, participants saw two objects and were for instance asked *Please give me the full one*. Because *full* has a maximum standard, participants should accept this request in a felicitous context with a maximally and a partially full container, but reject it in an infelicitous context with two partially full containers filled to different degrees. The adults performed as expected and rejected the request in the infelicitous context for all four absolute gradable adjectives. The 3- to 5-year-old children, in contrast, selected the fuller of the two partially full containers instead of rejecting the request. This non-target pattern was also found in the 3-year-olds’ responses to the maximum absolute gradable adjective *straight*. Notably, the children rejected infelicitous requests containing the minimum absolute gradable adjectives *spotted* and *bumpy*. These findings for maximum absolute gradable adjectives suggest that up to age 5 children do not yet restrict context-sensitive interpretations to relative gradable adjectives.

To assess whether participants have an endpoint-standard for absolute gradable adjectives, Foppolo and Panzeri (2013, for Italian) and Syrett et al. (2006, for English) used a ‘Scalar Judgement Task’. In this task, participants saw a series of objects that displayed the same property but to different extents. For each object a participant was asked ‘Is this *ADJ*?’, e.g., *Is this full?* That is, participants had to judge for each of the objects in the series whether the property introduced by an adjective is true. For absolute gradable adjectives with a minimum standard (e.g., *spotted*), a yes-response was expected for all objects except the object with a zero degree of the property, i.e., all objects with one spot or more. In contrast, for maximum absolute gradable adjectives (e.g., *full*) a yes-response was expected only for objects with a maximal degree of the property. For minimum absolute gradable adjectives adults and children
responded as expected. Unexpected results were found for full: 3- to 5-year-old English- and Italian speaking children—as well as some adults—judged containers that were not maximally full as full. This result points to the possibility of a non-endpoint standard for maximum absolute gradable adjectives.

The finding for full was replicated and extended to the maximum absolute gradable adjective empty in Foppolo and Panzeri’s (2013) study. This study allows first insights into the question of whether maximum and minimum absolute gradable adjectives are interpreted as complementary because antonym pairs were included in their Scalar Judgement Task. The results for antonym pairs such as clean and dirty indicate a complementary interpretation: adults and children only judged objects without any dirt as clean. Conversely, all objects with some amount of dirt were judged as dirty. Note that participants seem to have received test sentences either with the positive or with the negative adjective. Accordingly, this study leaves open whether the interpretation of antonyms as complementary is maintained when participants are presented with both adjectives using the same series of objects. First results from 5-year-old German-speaking children and adults (Weicker and Schulz, 2018) address this question: for the same series of objects, participants selected only objects without any dirt as clean and conversely, all objects with some amount of dirt as dirty. In other words, there were no objects that satisfied neither clean nor dirty.

In short, previous empirical findings for adults and children support the theoretical analysis that relative gradable adjectives are vague predicates. Regarding the question of whether absolute gradable adjectives differ from relative gradable adjectives in terms of vagueness, the empirical evidence to date is mixed. The present study contributes to the empirical research on absolute gradable adjectives by using a novel experimental design for German.

4. Our study on absolute gradable adjectives

The present study examines whether German-speaking children and adults interpret absolute gradable adjectives as not vague. More specifically, we asked four research questions:

(Q1) Do adults and children have an endpoint-standard for absolute gradable adjectives?
(Q2) Do adults and children interpret absolute gradable antonyms as complementary?
(Q3) Do borderline cases exist for absolute gradable predicates?
(Q4) Do children’s interpretation patterns change with age?

Children between ages 3 and 5 were tested. This is because children at age 3 are known to use adjectives from different semantic classes productively (Blackwell, 2005; Tribushinina et al., 2014; Weicker, 2019) and to be sensitive to the meaning differences between different adjective classes (Foppolo & Panzeri, 2013; Syrett et al., 2006; Syrett et al., 2010). At the same time, three-year-olds have been reported to have not yet mastered the meaning of gradable adjectives (see Section 3). Thus, investigating children’s interpretation of gradable adjectives between the ages of 3 and 5 can uncover at which point in the acquisition process the adult interpretation pattern emerges and how children arrive at this interpretation.
4.1. Participants

Forty-three monolingual German-speaking children participated in the experiment: 11 three-year-olds (5 girls, 6 boys, age range = 3;2 to 3;11 years, mean age = 3;7 years), 15 four-year-olds (7 girls, 8 boys, age range = 4;1 to 4;11 years, mean age = 4;6 years) and 17 five-year-olds (9 girls, 8 boys, age range = 5;0 to 5;9 years, mean age = 5;4 years). All children in our study were typically-developing, as ensured via a standardized language test (SETK 3-5, Grimm, 2001). The children were tested at their day-care centers in the Frankfurt area. Additionally, 26 undergraduate students of Goethe University with little or no background in linguistics (22 female, 4 male), all native speakers of German, took part in the experiment. They received compensation for participation.

4.2. Method

4.2.1. Materials

Like Barner and Snedeker (2008) and Solt and Gotzner (2010) in their studies of relative gradable adjectives, we employed the method of picture selection. In our task participants saw eight picture cards (14x14 cm) simultaneously. On each picture card a single object, a ball or a teddy, was depicted. The objects differed in color and changed from dirty to clean (see Figure 1). Different from previous studies investigating the interpretation of absolute gradable adjectives (Foppolo and Panzeri, 2013; Syrett et al., 2006), the objects were presented in random fashion (see Figure 1). This way, participants had to make their picture selection based on their own ordering rather than from a given order. All test prompts had the form ‘Please give me the ADJ Plural N Plural’, e.g., Gib mir bitte die dreckigen Bälle ‘Please give me the dirty balls’. The test prompts were uttered with a non-contrastive intonation. The adjectives tested were the maximum absolute gradable adjective sauber (‘clean’) and the minimum absolute gradable adjective dreckig (‘dirty’); the nouns were Teddy (‘teddy’) and Ball (‘ball’). The participants received a total of four test items, two trials per adjective.
Crucially, the visual set up for clean and dirty was identical (see Figure 1). This way, it was possible to determine whether participants interpret these antonyms as complementary, i.e., as direct opposites. In this case, objects that are selected when asked for clean balls/teddies will not be selected when asked for dirty balls/teddies and vice versa. In other words, objects that were judged clean were judged not dirty and, conversely, objects that were judged dirty were judged not clean (see example (5)). Alternatively, if participants interpret antonyms as non-complementary, some objects will be neither selected when asked for clean balls/teddies nor when asked for dirty balls/teddies. That is, there are objects that count neither as clean nor as dirty (see example (6)).

In addition to the test trials, we added a total of eight filler items to the experiment for two reasons. First, the filler items increased the distance between test trials including the same adjectives to minimize potential influences from the prior presentation. Second, the filler items served to implement the overall set up of the experiment as a game, which requires taking turns. In the test trials a puppet, played by the experimenter, made a request and the participant had to select the matching objects; in the filler trials, the participant had to make a request and the puppet selected the matching picture cards (see Section 4.2.2. for details of the procedure). As illustrated in Figure 2, the filler trials also consisted of eight picture cards, but the picture cards in each trial showed toys from two different basic-level categories (book, bucket, dice, Lego® brick, soccer ball). In each trial, the objects differed in color and shape. The requests the participant was expected to make were similar to the test prompts. Due to the different objects and different properties (red, blue, round, square) displayed on the cards, the expected requests were of the form *Gib mir bitte die roten Legosteine* ‘Please give me the red Lego bricks’.

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3 The numbers on the picture cards were not present in the actual experiment. They are added here for easier reference to the objects in Section 4.3. (‘Results’).
Before the test and the filler trials were administered, the participants were introduced to the objects and their names and were familiarized with the task. First, the experimenter showed a single exemplar of each object on a picture card and asked the participant to label them. Then participants received three practice trials, which did not contain any adjective (e.g., *Gib mir bitte die Puppen* ‘Please give me the dolls’). Recall that for the test trials containing *clean*, only one object in the visual set up showed this property (i.e., is maximally clean) and for the test trials containing *dirty*, several objects showed that property (see Figure 1). Nevertheless, all requests were of the same form: they all contained a plural DP (e.g., *clean teddies*). Therefore, in the practice trials the number of objects showing a property (e.g., being a doll) varied; for one trial only one object fitted the description. This way, we illustrated that selecting only one object was a licit choice. For the practice trials participants received feedback: if they noticed that only one object matched the description, the experimenter emphasized that the puppet’s request was the same independent of the number of matching objects. The experimenter also corrected the participant if she forgot to select one of the required objects.

4.2.2. Procedure

The testing was conducted in two separate sessions. In the first session, participants received the test trials containing the maximum absolute gradable adjective *clean*; in the second session, participants received the trials containing the minimum gradable adjective *dirty*. The visual displays and order of presentation were the same in both sessions. This way, we were able to compare the object choices for *clean* and *dirty* directly. To minimize possible influences from participants’ choices in the first session to their choices in the second session, we ran the sessions about twelve days apart. The testing took place for all participants individually in a quiet room: for the children at their day-care centers and for the adults at their university. The participants and the experimenter sat next to each other on the floor or at a table large enough to display the eight picture cards per trial simultaneously.

At the beginning of each session the experimenter introduced the participant to a hand puppet and explained that the puppet wanted to play a game. The puppet and the participant each received a special dice that they had to use, keeping the outcome a secret. This set-up served to engage the children in a situation that naturally requires taking turns. The participants’ dice
showed four options: square, circle, blue dot, red dot. If it was the participant’s turn, the experimenter distributed the eight picture cards on the table and the participant rolled her dice. When the dice showed ‘blue’, for example, she had to ask the puppet to hand her the blue toys, etc. The participant’s requests corresponded to the filler trials. If it was the puppet’s turn, the experimenter distributed the picture cards on the table as well, and the puppet rolled her dice and made her request to the participant. The puppet’s requests corresponded to the test trials. The participant’s task was to select those objects that in her opinion matched the test prompt.

4.2.3. Data analysis

The analysis is based on the participants’ object choices when asked to pick the clean or dirty objects, respectively. We analyzed the data in two ways. First, for the group analysis we calculated the percentage of selections for each of the eight objects across the two trials per adjective. Second, for each participant and for each of the four test trials we defined the cut-off point for clean and dirty, i.e., the dirtiest object selected as clean (together with all cleaner objects) and the cleanest object selected as dirty (together with all dirtier objects). The group and the individual analyses allow us determine the standard of comparison for clean and dirty. By directly comparing participants’ cut-off points for both antonyms we are able to assess whether they were complementary or non-complementary. From this relation we can infer whether borderline cases exist for clean and dirty.

4.3. Results

To find out whether children and adults have an endpoint-standard for absolute gradable adjectives (Q1), we calculated how often participants selected the respective objects 1 to 8 (see Figure 1a and b). The results for clean are given in Figure 3 and the results for dirty are given in Figure 4. For each of the objects, 22 responses per adjective were analyzed in the group of 3-year-olds (2 trials x 11 participants), 30 responses per adjective in the group of 4-year-olds (2 trials x 15 participants) and 34 responses per adjective in the group of 5-year-olds (2 trials x 17 participants). A total of 52 responses per adjective were analyzed in the adult group (2 trials x 26 participants). In Figure 3 and Figure 4, the eight objects are plotted by number on the x-axis (1 = dirtiest object, 8 = cleanest object). Note that they are ordered linearly only for the ease of illustration. The y-axis displays how often the respective objects were selected. The raw numbers are given in the Appendix.

When asked for clean, the adults only selected object 8, which is the maximally clean object, i.e., the object that was without any dirt. The choice patterns for the three child groups is similar to the adults’. However, all child groups also sometimes selected object 7, which had one spot of dirt on it, as clean. The number of choices for object 7 decreased with age. Note that the patterns for the 3-year-olds and for the 4-year-olds differed slightly from the 5-year-olds: in total, in 7.5% of the clean-trials all objects were selected; this was due to three children.4

4 It is unlikely that these three children simply did not understand the task, because they did not select all objects across all trials. Therefore, we did not remove these children from the analysis. For the question of why some children responded this way, see the discussion in Weicker (2019).
Although the patterns differed slightly between the groups, the median\(^5\) cut-off point for *clean* was identical across age groups and trials, namely 8.0. That is, the distribution of cut-off points did not differ significantly across age groups, *clean teddies*: $\chi^2(3) = 5.51, p = .138$; *clean balls*: $\chi^2(3) = 7.64, p = .054$. Importantly, the standard of comparison was the maximal endpoint of the scale.

![Figure 3. Percentage of choices for clean-trials per age group. Number 1 displays the dirtiest object, number 8 the cleanest object.](image)

The adults’ choices for *dirty* show that every object that contained some amount of dirt (objects 1-7) was selected as dirty. The clean object (object 8) was never selected. Again, the children’s choices differed slightly because either not all dirty objects were selected or the clean object was selected as well. The 3-year-olds selected the dirty objects less often: objects that were only slightly dirty were sometimes not considered *dirty*. However, as for *clean*, the median cut-off point for *dirty* was identical across age groups and trials, namely 7.0. That is, the distribution of cut-off points did not differ significantly across age groups, *dirty teddies*: $\chi^2(3) = 3.47, p = .325$; *dirty balls*: $\chi^2(3) = 2.84, p = .417$. Here, the standard of comparison was the minimal endpoint of the scale. As for (Q1) we can conclude that adults and children have an endpoint-standard for absolute gradable adjectives.

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\(^5\) The median was chosen as the measure of central tendency because for the present purposes it is more suitable than the arithmetic mean. When talking about objects a median cut-off point of 8.0, for instance, is more meaningful than a mean cut-off point of 7.9. In addition, the median is the “typical” cut-off point in the distribution because it is less affected by extreme scores than the arithmetic mean (Field, 2009), e.g., when children selected all objects.
Comparing the cut-off points for clean and dirty based on the group data indicates that adults and children interpret absolute gradable adjectives as complementary (Q2): participants’ object selections for clean are the mirror image of their object selections for dirty and vice versa. Further evidence for this interpretation is provided by the individual analysis. For the majority of participants (59 out of 69, 86%), objects are either clean or dirty across trials. Among these are 6 of the 11 3-year-olds, 13 of the 15 4-year-olds, 14 of the 17 5-year-olds, and all 26 adults. Put differently, these 59 participants judged every object that they did not judge dirty as clean and vice versa (see example (5)). Interestingly, only one 3-year-old child considered some objects as neither clean nor dirty, which indicates a non-complementary interpretation. How can we classify the remaining nine participants that show neither a non-complementary nor a consistent complementary interpretation of absolute gradable adjectives? Four of them (one 3-year-old and three 5-year-olds) had an inconsistent complementary interpretation, i.e., only for one visual set up (e.g., only for clean and dirty balls). For one 3-year-old and one 5-year-old with an inconsistent complementary interpretation and one additional 3-year-old the object with one spot of dirt was considered both dirty and clean. Possibly, children selected this object when asked for clean and when asked for dirty because they judge it neither clearly dirty nor clearly clean. Hence, this specific object may constitute a borderline case, which suggests that three participants assume that borderline cases exist for absolute gradable adjectives (Q3). The responses of four children were unanalyzable. As for (Q4), interpretation patterns changed only slightly across age, as demonstrated by the fact that the cut off-point was the same for all age groups across trials.

5. Discussion and conclusion

The present study used a picture-selection task that was implemented as a game. The objects on the pictures all belong to the same superordinate-level category, namely toys. Participants had to make their choices based on their own ordering of the objects presented. Initial practice trials served to illustrate that the number of objects matching the request could vary. Accordingly, in the test trials participants could in principle select as many or as few objects
matching their interpretation of the test prompt as they thought appropriate. This way, participants’ interpretation of absolute gradable adjectives could be inferred from their object choices in a natural setting. Our findings suggest that adults interpret the absolute gradable adjectives clean and dirty as not vague – at least in the contexts we created. Children as young as age 3 share this interpretation overall. (Q1) asked whether participants have an endpoint-standard for absolute gradable adjectives. The data of the adult group revealed that the standard of comparison for clean and dirty is the maximal and minimal endpoint of the scale, respectively. This data confirms the judgements in examples (3a) and (3b): if something has some dirt on it, it must be dirty; if something is clean, it cannot be cleaner. The data of the 3-, 4-, and 5-year-old groups show a very similar interpretation pattern. (Q2) asked whether participants interpret absolute gradable adjectives as complementary. The group data as well as the individual data of adults and children support the interpretation of absolute gradable adjectives as complementary, as illustrated in example (5). A comparison of the object selections for clean and dirty showed that the majority of adult and child participants considered objects either clean or dirty. Put differently, for them every object that is clean is not dirty and conversely, every object that is dirty is not clean. Hence, there were no objects that were considered neither clean nor dirty, which is in contrast to non-complementary adjectives such as big (see example (4)). Given this finding, we conclude that borderline cases do not seem to exist for absolute gradable adjectives (Q3). (Q4) addressed the question of whether interpretation patterns change with age. We found that the adult interpretation pattern is already present in 3-year-old children and that across age interpretation patterns change only slightly. For instance, a few children did not interpret absolute gradable adjectives as complementary across the visual contexts; they sometimes had a non-maximal standard for clean or a non-minimal standard for dirty, or they selected the object with one spot of dirt both when asked for dirty and when asked for clean.

The picture-selection task used in the present study allowed us to extrapolate participants’ interpretation of absolute gradable adjectives from their object choices. To probe whether children’s rare deviations from the adult pattern indeed reflect a non-adult-like meaning of absolute gradable adjectives, future studies could include truth-value judgements, which require explicit decisions on the part of the participants (for this method in adult studies: see Alxatib and Pelletier, 2011; Égré and Zehr, 2018). Truth-value judgements could assess directly whether children accept or reject descriptions containing an absolute gradable adjective and its negation for specific objects (e.g., This teddy is dirty, This teddy is clean, This teddy is not dirty, This teddy is dirty and clean or This teddy is neither dirty nor clean as descriptions of object 7 in Figure 1).

In summary, our results from a picture-selection task in German with 26 adults and 43 three- to five-year-old children provide first empirical evidence that not all gradable adjectives are interpreted as vague. For the contexts we created, adults consistently opted for a non-vague, i.e., precise, interpretation of absolute gradable adjectives: absolute gradable adjectives did not have context-sensitive interpretations and did not give rise to borderline cases. What is more, the child data revealed that this interpretation of absolute gradable adjectives as not vague is already present by age 3. To evaluate the robustness of this pattern, future studies should vary the contexts in a way that makes the imprecise reading of absolute gradable adjectives more readily available.
We conclude by suggesting that theories on vagueness and gradable adjectives can benefit from taking into account the finding that young language learners are sensitive to the differences between absolute and relative gradable adjectives regarding vagueness. Two questions remain open. First, it is unclear whether children arrive at the non-vague interpretation of absolute gradable adjectives because they are sensitive to semantic differences between absolute and relative gradable adjectives or because they have not yet acquired the pragmatic mechanisms necessary to interpret absolute gradable adjectives as vague. Second, it is unclear in which contexts both adults and children may opt for a vague reading of absolute gradable adjectives.

Appendix

Table 1. Number of choices for each object in clean-trials per age group.

<table>
<thead>
<tr>
<th>Age</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Adults</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Number of choices for each object in dirty-trials per age group.

<table>
<thead>
<tr>
<th>Age</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>Adults</td>
<td>52</td>
</tr>
</tbody>
</table>

References


Merle Weicker and Petra Schulz

Implying or implicating not both in declaratives and interrogatives
Matthijs WESTERA — Universitat Pompeu Fabra

Abstract. Both disjunctive assertions and disjunctive questions can imply “not both”, i.e., that only one of the disjuncts is true. For assertions this is known to be part of what the speaker means (e.g., an implicature), whereas for questions this is instead a presupposition. This puzzle is challenging for predominant pragmatic and grammatical accounts of exhaustivity in the literature. This paper outlines a solution based on Attentional Pragmatics combined with (other) general pragmatic principles.

Keywords: exhaustivity, implicature, presupposition, disjunction, alternative question, pragmatics, intonation.

1. Introduction

Both assertions and questions exhibit so-called exhaustivity effects. For instance, disjunctions of either type imply ‘not both’: 2

\[
\begin{align*}
(1) & \quad \text{a. John was at the party, or Mary.} \quad \text{Implied: not both (meant)} \\
& \quad \text{b. Was John at the party, or Mary?} \quad \text{Implied: not both (not meant)}
\end{align*}
\]

Ideally, a theory of exhaustivity would deliver these implications in more or less the same way. At the same time, however, there is a difference: the ‘not both’ implication is commonly claimed to be part of what the speaker means in the case of assertions, like (1a), e.g., it is often called an implicature, but not in the case of questions, like (1b), where it has been claimed to be presupposed instead. I will review some of the evidence for this difference in section 3.

Let me briefly clarify the terminology in which the puzzle is framed. Utterances imply many things that are not part of what is meant. For instance, hearing me utter “It’s raining” implies that I know those English words, hearing me say it with the accent I have will tell you I am likely Dutch. It will also imply (through an assumption of cooperativity) that I believe that it is indeed raining. Yet none of these implications are part of what I meant by the utterance. What I meant, after all, is that it is raining, not that I believe it, let alone that I know the words or am not a native speaker. This shows that explaining the presence of an implication, and explaining why it is or is not part of what is meant, are two separate things.

The challenge posed by (1) is, in a nutshell, to explain the exhaustivity implications of (1a) and (1b) in a more or less uniform way, while also accounting for the difference in status of this implication as part or not part of what is meant. The approach taken in this paper is based on two core assumptions. First, exhaustivity implications do not depend on reasoning about the informational strength of an utterance (as in standard pragmatic and grammatical approaches to exhaustivity), but on reasoning about what an utterance draws attention to (Westera, 2017b). Since this is a semantic/pragmatic dimension that questions and assertions share, this enables a uniform treatment of the exhaustivity implications of (1a) and (1b). Second, exhaustivity is part

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1I would like to thank Jeroen Groenendijk and Floris Roelofsen for very useful commentary on this work in an early stage.

2The intended intonation here has a final low boundary tone and focus accents on each disjunct.
of what is meant in (1a) but not in (1b), because it is only relevant in the former, and whatever a speaker means should be relevant. Of course the latter relies on several assumptions about relevance and questions vs. assertions which require substantial motivation and discussion.

Section 2 gives a summary of related work, section 3 considers some evidence from the literature corroborating the empirical puzzle, section 4 presents my account, and section 5 reflects on the required assumptions in more detail. Section 6 concludes.

2. Related work

Exhaustivity effects are often indiscriminately called ‘implicatures’ in the literature. Though strictly speaking signifying an (indirectly communicated) component of what is meant (Grice, 1975), the label ‘implicate’ is often used as synonymous with ‘implication’ (and ‘inference’); in the grammatical approach to exhaustivity (see below) it is used even for what are treated as semantic entailments. Definitions of implicature in the literature often deviate from Grice’s, and can differ even between authors whose informal conceptions of implicature seem to align. For instance, Gazdar (1979: p.38) defines it as something which is implied by the utterance of a sentence but that is not an entailment of the sentence’s semantic meaning; Levinson (1983) defines it as a type of inference drawn by an audience; Gamut (1991: vol.1, p.207) define it as any logical consequence of “the conditions under which a sentence can correctly be used”. This variation in definitions of implicature may be symptomatic of a number of misconceptions (see Bach, 2006). In the present paper ‘implicature’ is used strictly in the Gricean (1975) sense, as a certain type of component of what the speaker means.

It is not clear which of the predominant accounts of exhaustivity in the literature would be best equipped to handle the main puzzle of this paper, i.e., (1a,b). The traditional pragmatic approach is based on the Gricean maxim of Quantity: The speaker is implied to not believe that ‘both’ is true, because otherwise they would have asserted that instead of the (less informative) disjunction (for a critical discussion see Geurts, 2011). This is supposed to deliver the exhaustivity implications of assertions, but it does not extend to questions: In (1b) the speaker did not assert the conjunction, but they did not assert the disjunction either, and yet the latter does not end up being excluded as exhaustivity. More conceptually, only assertions involve the communication of a piece of information on which the maxim of Quantity can operate; the Gricean maxims simply do not apply to questions (requiring, instead, some other set of maxims). Moreover, pragmatic accounts have tended to gloss over the issue entirely of why exhaustivity should be part of what the speaker means, i.e., why it should be an implicature as opposed to merely a pragmatic implication: Authors simply stop as soon as the implication is delivered.

The more recent grammatical approach (e.g., Chierchia et al., 2012), which delivers exhaustivity through the insertion of grammatical operators, likewise faces a challenge. Grammatical operators make exhaustivity part of the core meaning, essentially as a semantic entailment. While this arguably predicts exhaustivity to be part of what is meant in the case of assertions, where semantic entailments end up being part of the assertion, it does not seem to apply to questions. After all, entailments do not generally ‘survive’ questioning force, e.g., “Does John sleep?” does not entail that John sleeps, or even presuppose it. Accordingly, it is not clear how the grammatical approach, by incorporating exhaustivity as an entailment into the semantics of a sentence, could deliver the exhaustivity implications of questions.
The explanation that I will propose is based on a different approach to exhaustivity altogether, Attentional Pragmatics (Westera, 2017b), which was motivated by a number of independent shortcomings for both aforementioned approaches – it was not aimed specifically at the puzzle at hand. The present paper is a more focused, less formal, more self-contained part of chapter 12 in Westera (2017b). For a more self-contained introduction to Attentional Pragmatics see Westera (2017a); Westera (2020a)[under review]; for a more detailed comparison in particular to the grammatical approach (focused on so-called Hurford disjunctions) see Westera (2020b)[under review].

3. The empirical puzzle

The central puzzle in this paper is that whereas (1a) and (1b) share the same exhaustivity implication, the exhaustivity is a component of what the speaker means only in (1a), not in (1b):

(1)  
   a. John was at the party, or Mary.  \hspace{1cm} \textbf{Implied:} not both (\textit{meant})  
   b. Was John at the party, or Mary?  \hspace{1cm} \textbf{Implied:} not both (\textit{not meant})

The exhaustivity effects of assertions, and especially the ‘not both’ effect of disjunctions, have long been considered a prime example of conversational implicature, hence part of what is meant. Now, within the grammatical approach to exhaustivity this view appears to have been abandoned, but only, it seems, in favor of an account in which exhaustivity is made an even more central part of what is meant, by having it contribute to the core compositional semantics. By contrast to assertions, the exhaustivity effects of disjunctive questions have long been noted not to be part of what the speaker means but rather to be presupposed (e.g., Bartels, 1999; Aloni and Égré, 2010; Rawlins, 2008; Biezma, 2009; Biezma and Rawlins, 2012) or, a terminological variation, imposed on the common ground (Pruitt and Roelofsen, 2011).

The consensus in the literature about the status of exhaustivity (as part or not part of what is meant) has led to this being subjected to only little empirical investigation. However, a telling experiment concerning assertions is presented by Destruel et al. (2015), who use the appropriateness of “no” vs. “yes, but...” as a diagnostic for at-issueness, in examples like the following (though the experiment was in German):

(2)  
   A: The soup is warm. (L\%)
   B: No, it is hot. / ?? Yes, but/and it is hot.

Destruel et al. (2015) find that exhaustivity is, with overwhelming preference, contradicted by means of “no” as opposed to “yes, but...” (also “yes, and...”). From a comparison with other types of constructions they conclude, moreover, that content which is preferably denied by “no” is at-issue content in the sense of Simons et al. (2010), who define it (p.323) as part of what the speaker means (albeit in terms of a speaker’s intentionally recognizable communicative intention; see also Goodhue and Wagner, 2018 for the relation between “yes”/“no” and at-issueness). Although Destruel et al. do not consider the ‘not both’ effect of disjunctions, it clearly obeys the same pattern they find for other exhaustivity effects:

(3)  
   A: John was at the party, or Mary. (L\%)
   B: No, both were there. / ?? Yes, and/but both were there.
As for exhaustivity on questions, consider the interrogative counterpart of (3), adapted from Roelofsen and Farkas (2015):

(4) A: Was John at the party, or Mary? (L%)  
   Implied: not both (not meant)  
   B: ?? Yes, not both. / ?? No, both were there. / Actually, both were there.

As observed by Roelofsen and Farkas, in this case the ‘not both’ implication cannot be targeted by either ‘yes’ or ‘no’; negating it requires a marker like ‘actually’. Accordingly, the ‘not both’ exhaustivity implication of disjunctive questions appears not to be at-issue. In line with existing characterizations (cited above), this would be because the exhaustivity is not part of what is meant but merely implied (and implied to be already known, i.e., presupposed).

Alternatively, one might try to explain the infelicity of “yes” and “no” in (4) by appealing to the fact that it is not what some would call a “yes/no question” (but cf. Bolinger, 1978; Bäuerle, 1979; Biezma and Rawlins, 2012). Note however that “yes” and “no” in (4) are meant to address not the question itself but its would-be implicature, “not both”. Note, furthermore, that it is possible in principle to target the implicatures of (non-“yes/no”) questions by “yes” and “no”, e.g., the following dialogues are fine:

(5) A: Speaking of Trump, how is he still our president?!  
   Implied: (e.g.,) he is a bad president.  
   B: Yes, he’s a total failure. / No, I think he has done good things.

(6) A: What are you doing here?  
   B: How is that any of your business?  
   A: No, it is, I work here.

What (4) seems to show, therefore, is not the supposed infelicity of “yes” and “no” in response to supposed non-“yes/no”-questions in general – something which would of course be in need of explanation in its own right – but the absence of a suitable implicature for these response particles to target.

Now, the evidence in (4) is less strong than that in (3), because whereas being at-issue implies being part of what is meant, the opposite does not hold. For instance, parenthetical remarks clearly express something that is part of what the speaker meant but which is not the main point of the utterance. Let me employ another diagnostic to further support the assumed presupposition status of ‘not both’ in (4), namely the “hey wait a minute” test:

(7) A: Was John at the party, or Mary?  
   Implied: not both (not meant)  
   B: Hey wait a minute, is not it possible that both were there?

3An anonymous reviewer notes that these are rhetorical questions, and that the assertoric nature of rhetorical questions may be to blame for the felicity of “yes”/“no” in these cases. That may be so, but in my view their assertoric nature is explained precisely by the presence of a conversational implicature (i.e., an indirectly conveyed intention to inform), not the other way around. It is difficult to find or construct a natural question that conversationally implicates something without this implicature overshadowing the main questioning act, i.e., without giving it a rhetorical flavor – but perhaps example (9) further below is such a case.
These particular examples were not intended to support any new empirical claim, but merely to illustrate the pattern of interest. The different status of exhaustivity in assertions vs. questions is widely assumed, across many different theoretical strands in the literature. In what follows I will therefore take this pattern for granted and seek an explanation.

4. The account

I will list all necessary assumptions up front, and explain how they interact to solve the central puzzle, before motivating each assumption in more detail in section 5. The assumptions are:

A. **QUDs**: The set of all ‘in principle relevant’ propositions, say, all pieces of information deemed worth making common ground at some point in the current discourse, is subdivided into QUDs (questions under discussion), roughly, ‘ways of being relevant’, of which one or several may be active, i.e., to be addressed by the current utterance (e.g., Roberts, 2012).

B. **I(nformation)-maxims**: A cooperative speaker will intend to communicate (or mean) all and only information they believe to be true that is relevant to some active QUD (essentially Grice, 1975; more precisely the definition in Westera, 2017b).

C. **A(ttention)-maxims**: A cooperative speaker will intend to draw attention to all propositions the speaker considers possible and that are relevant to some active QUD (Westera, 2017b).

D. **Symmetry**: If an active QUD contains a proposition $p$, then its negation $\neg p$ is also contained in an active QUD (e.g., Chierchia et al., 2012; though typically not for the same reasons, and not in the same QUD, e.g., Horn, 1989; Westera, 2017c).

E. **Closure**: QUDs are by default assumed to be closed under conjunction (e.g., Schulz and Van Rooij, 2006; Spector, 2007); this can be overruled by context and by other principles such as assumption G. below.

F. **Table**: Interrogatives normally serve to introduce a new QUD to the table, while declaratives presuppose (accommodatably) a pre-existing QUD (ibid.; Farkas and Bruce, 2010).

G. **Possibility**: A speaker who introduces a new QUD to the table should consider all propositions it contains possible (e.g., Roberts, 2012).

H. **Disjunction**: ‘Contrastive’ focus intonation on the disjuncts, as intended in (1a,b), indicates that the QUD is supposed to contain the individual disjuncts (e.g., Biezma and Rawlins, 2012).

I. **Low boundary tones (L%)**: The L%, as in both (1a,b), indicates that the utterance is intended to comply with all the conversational maxims as far as the main QUD goes (Westera, 2018).

None of these are new to the present paper, all of them are fairly general, and all of them should sound quite plausible on the surface (though this may be subjective).

The way in which these assumptions interact to predict and explain the pattern in (1a,b) is as follows. Starting with the exhaustivity in (1a), where it is part of what is meant:
1. Given the final fall (L%), the speaker must believe that their utterance complies with the I-maxims and A-maxims relative to the main QUD (assumption I.);

2. Given the contrastive intonation, the QUD is supposed to contain the individual disjuncts (by assumption H.), and given 1. this must indeed be the case;

3. Hence their conjunction ‘both’ too is contained in that QUD, by the default assumption of closure of QUDs under intersection (assumption E.);

4. Compliance with the A-maxims (as per 1.) implies that the speaker must have mentioned (i.e., drawn attention to) all relevant propositions they consider possible (assumption C.);

5. Since the speaker did not mention the ‘both’ proposition (which they could have done by adding “or both”), they must not consider it possible; put differently, the speaker must believe ‘not both’, i.e., exhaustivity;

6. Because ‘both’ is relevant (step 2.), their negation ‘not both’ must be relevant too (assumption D.);

7. And therefore in (1a) the exhaustivity must be part of what is meant (B. & I.).

In a nutshell, because ‘both’ is relevant to the main QUD, the low boundary tone entails its exclusion, i.e., ‘not both’; and since the latter is relevant too, it must be part of what the speaker means.

Things are a bit different for (1b), although the first two steps are the same:

1. Given the final fall (L%), the speaker must believe that their utterance complies with the I-maxims and A-maxims relative to the main QUD (assumption I.).

2. Given the contrastive intonation, the QUD is supposed to contain the individual disjuncts (by assumption H.), and given 1. this must indeed be the case.

3. But this time their conjunction ‘both’ cannot be (despite G.), because:
   i. Suppose (to obtain a contradiction) that the conjunction ‘both’ is relevant.
   ii. Since (1b) is an interrogative, it serves to introduce a new QUD (F.).
   iii. To introduce a new QUD that contains the proposition ‘both’, this proposition would have to be considered possible (G.).
   iv. Given 1. and the definition of the A-maxims, because ‘both’ was not mentioned, we know that the speaker must not consider it possible (C. &).

   There is a contradiction between iii. and iv., so the conjunction ‘both’ cannot be relevant.

4. The reason why ‘both’ is not relevant (despite D.), must be that it was not considered possible (as required by G.).

5. Put differently, the speaker must believe ‘not both’, i.e., exhaustivity.

6. But since ‘both’ is not relevant, its negation ‘not both’ cannot be relevant either (F.).

7. Hence in (1b) the exhaustivity cannot be part of what is meant (B. & I.).
In a nutshell, this time ‘both’ cannot be relevant, because if it had been relevant then the speaker – now responsible for introducing the QUD – should have included it in the QUD and hence drawn attention to it.

Even if one finds all the assumptions plausible and the logical derivation steps valid, it may be difficult to grasp the full explanation. Here are two partial paraphrases that should enable the well-rested reader to represent reasonable portions of the account in mind at once:

• Exhaustivity in assertions such as (1a) is the exclusion of relevant alternatives that were not mentioned, whereas in questions such as (1b) it is the exclusion of irrelevant alternatives that would have been relevant (hence mentioned) had they been considered possible.

• Exhaustivity is part of what is meant in (1a) but not (1b), because in the former nothing prevents the default closure of relevance under conjunction and then negation that makes exhaustivity relevant, whereas in the latter such closure is prevented by the fact that interrogatives introduce a new QUD, whose propositions must be considered possible.

Another way of gaining further insight into how the explanations work is to try to break certain steps of the derivation and see how the resulting predictions are different. For instance, recall that the explanations rely on assumptions about relevance or irrelevance of “both”, namely, closure under intersection by default, which is prevented in the case of questions that introduce a new QUD. Let us try to override these assumptions by context and see what happens:

(8) A: Was John there, or Mary, or Bill?
B: John was there, or Mary.
Prediction: ‘not both’ not part of what B meant.

(9) A: Was John there, or Mary, or both?
B: Was John there, or Mary?
Prediction: ‘not both’ is part of what B meant.

In (8) A’s question already implies that no combination of two or three individuals was there, in particular not both John and Mary. Accordingly, this is no longer relevant by the time B utters the disjunctive assertion, making this a case where closure under intersection does not hold even for an assertion. By contrast, (9) is a situation where A’s initial question explicitly makes ‘both’ relevant, and speaker B arguably is not introducing a new QUD even though B is using an interrogative, making this case where the QUD for B is closed under intersection despite her uttering an interrogative. The prediction for (8), therefore, is that ‘not both’ is not part of what B meant, and vice versa for (9), contrary to the usual pattern.\(^4\) This prediction seems to me immediately plausible for (8), which is a fairly straightforward interaction; but (9) is a bit odd for independent reasons – replying to a question by asking another, narrower question is non-standard – so let me clarify the intended reading of (9). In particular, the intended reading of (9) is not one where B asks a sub-question as part of a discourse strategy for resolving A’s original question (Roberts, 2012). Rather, the intended reading is one where B is actually resolving part of A’s question by conversationally implicating ‘not both’. Combined

\(^4\)In addition, it is predicted that (8) cannot imply ‘not both’ in the usual way – ‘both’ is not relevant, after all. To the extent that B’s utterance does still imply ‘not both’, this seems to me plausibly a consequence of B’s lack of protest to this presupposition of A’s utterance.
with B asking the remainder of the question, this makes it feel as if B is correcting A, as if B is saying: “The ‘both’ option is false, so this is the question you should have asked”. Under this reading I find the prediction that ‘not both’ is part of what is meant plausible.

Because all assumptions of the account are more general than the puzzle at hand, they yield predictions also for other types of utterances. For instance, I refer to Westera (2017b) for an account of simple (non-disjunctive) propositional questions as well as questions with a final high boundary tone; see Westera (2018) for an account of rising declaratives that relies on many of the same assumptions; see Meertens (2019) for an application to alternative questions.

5. A closer look at the assumptions

5.1. Assumptions B. & C.: Two sets of maxims

The explanation relies on two sets of maxims:

B. I(nformation)-maxims: A cooperative speaker will intend to communicate (or mean) all and only information they believe to be true that is relevant to some active QUD (essentially Grice, 1975; more precisely the definition in Westera, 2017b).

C. A(ttention)-maxims: A cooperative speaker will intend to draw attention to all propositions the speaker considers possible and that are relevant to some active QUD (Westera, 2017b).

The I(nformation)-maxims are essentially the Gricean (1975) maxims, of which I adopt the following definition (for formalization see Westera, 2017b): For each active QUD:

- **I-Quality**: Intend to communicate only propositions you believe are true;
- **I-Relation**: Intend to communicate only propositions contained in the QUD;
- **I-Quantity**: Intend to communicate the strongest propositions permitted by I-Quality and I-Relation.

The account relies on these maxims to derive that, given that ‘not both’ is implied to be believed by the speaker, it is part of what the speaker means (intends to communicate) if and only if it is relevant. More generally, the I-maxims predict that the contents of any implied belief will be part of what is meant if they are relevant, and not if they are not.

The A(ttention)-maxims are a more recent development (Westera, 2017a; building on Gazdar, 1979; Schulz and Van Rooij, 2006; Ciardelli et al., 2009). The main idea is that, besides intending to provide information, speakers also intentionally draw each other’s attention to certain possibilities. As a type of communicative intention, like information-sharing, attention-drawing must be governed by a set of conversational maxims:

- **A-Quality**: Intend to draw attention only to propositions you consider possible;
- **A-Relation**: Intend to draw attention only to propositions contained in the QUD;
- **A-Quantity**: Intend to draw attention to the maximal set of propositions permitted by A-Quality and A-Relation.

For a formal definition and motivation I refer to Westera (2017b).\(^5\)

\(^5\)The above presentation of the A-maxims is slightly simplified compared to Westera (2017b), but not in a way
The present account relies on the A-maxims, in particular A-Quantity, for delivering (the first step towards) exhaustivity, instead of the more common pragmatic approach which relies on I-Quantity (e.g., Geurts, 2011). In Westera (2017b) this shift from I-maxims to A-maxims is argued to solve a large number of problems (see also Westera, 2020a[under review]; Westera, 2020b[under review]). For present purposes deriving exhaustivity through the A-maxims is crucial because, whereas the I-maxims apply only to assertions (i.e., there needs to be an intention to inform), the A-maxims apply to assertions and questions alike: Although questions do not (primarily) serve to provide information, they do serve to draw attention to things.

This common starting point for exhaustivity on questions and assertions notwithstanding, recall that it nevertheless derives exhaustivity for (1a) and (1b) in slightly different ways. For (1a), given that the ‘both’ proposition is relevant, the maxim of A-Quantity directly lets us conclude that the speaker must not consider ‘both’ possible. By contrast, in (1b) the maxim of A-Quantity lets us conclude only that if the ‘both’ proposition is relevant, the speaker must not consider it possible – and we relied on other assumptions and a proof by contradiction to conclude from this that the ‘both’ proposition in (1b) cannot be relevant.

5.2. Assumptions A., D. & E.: Questions Under Discussion (QUDs)

In any discourse, a large number of pieces of information may be considered broadly ‘relevant’, in the sense of being considered worth making common ground. Assumption A., repeated here, states that we tend to subdivide this potentially quite large set of pieces of information into more focused subsets, or Questions Under Discussion (QUDs; e.g., Carlson, 1983; Roberts, 2012; Ginzburg, 1996), and that each utterance is aimed only at one or a small number of QUDs.

A. QUDs: The set of all ‘in principle relevant’ propositions, say, all pieces of information deemed worth making common ground at some point in the current discourse, is subdivided into QUDs (questions under discussion), roughly, ‘ways of being relevant’, of which one or several may be active, i.e., to be addressed by the current utterance.

QUDs are not actually ‘questions’, at least not in the sense of either interrogative sentences, their semantic contents, or the questioning speech acts expressed by them. Rather, a QUD represents a set of pieces of information that are considered worth making common ground and which share a certain subject matter or discursive function, by virtue of which it is reasonable for a speaker to pursue them jointly with a single utterance.

Recall that the I-maxims and A-maxims above were defined relative to the utterance’s QUD: It is only given a QUD that the maxims determine what is reasonable for a speaker to assert and draw attention to. This means that a different set of principles must be defined to govern which QUDs are reasonable for a speaker to pursue to begin with. Assumptions D. and E. below will be of this type. However, we do not need a full account of the principles governing QUDs for a pragmatic theory based on this notion to make predictions: An utterance itself also constrains what its QUD may be, by virtue of the maxims, but also by virtue of markers such as prosody.

Assumption D. claims that relevance is ‘symmetrical’:

that matters for present purposes. The full-fledged A-maxims include a requirement that every proposition in the attentional intent should be considered not only possible (A-Quality), but possible independently of any stronger proposition in the attentional intent.
D. **Symmetry**: if an active QUD contains a proposition $p$, then its negation $\neg p$ is also contained in an active QUD (e.g., Chierchia et al., 2012; though typically not for the same reasons, and not in the same QUD, e.g., Horn, 1989; Westera, 2017c).

The resulting account relies on this symmetry assumption to relate the (ir)relevance of ‘both’ to the (ir)relevance of ‘not both’ and, from there, to ‘not both’ being part or not part of what is meant. In this way Assumption D. effectively reduces the problem of why ‘not both’ is or is not part of what is meant, to the problem of why it is or is not relevant.

Now, assuming the symmetry of relevance can lead to the so-called *symmetry problem* for accounts of exhaustivity (e.g., Kroch, 1972; Chierchia et al., 2012; Westera, 2017c): If both a proposition and its negation are relevant alternatives for an utterance, then the same reasoning that leads to the exclusion of one (exhaustivity) will lead to the exclusion of the other – yet excluding both leads to a contradiction. The solution to this resides in realizing that, even though a proposition and its negation are both broadly speaking worth establishing, this does not mean that they will be grouped in the same QUD (Westera, 2017c) – and since the maxims operate only given a QUD, it is only the set of alternatives in the same (asymmetric) QUD that matters for exhaustivity. It is for this reason that Assumption D. crucially does not claim that a proposition and its negation are necessarily worth making common ground for the same reason, and that they would be necessarily grouped together in the same single QUD. Thus, we can adopt Assumption D. and yet maintain that the main QUD in an example such as (1a) contains only the positive propositions, i.e., that it is the QUD of who was at the party, not who was not.

More precisely, in the case of exhaustivity such as ‘not both’ in (1a), the assertion addresses the main QUD of who was at the party, while the ‘not both’ implicature addresses the secondary QUD of who was not at the party. There are several reasons for adopting this multi-QUD analysis of (1a), besides the necessity of breaking the symmetry for an account of exhaustivity, i.e., for avoiding the symmetry problem. One is that, if an utterance expresses multiple intents, such as a primary assertion and a conversational implicature, then each intent simply *must* relate to its own distinct QUD – this is because no two different intents can simultaneously comply with the maxims (as defined above) relative to the same single QUD. Another is the lack of a prosodic focus accent on the verb in (1a), which one would expect if propositions in the QUD had, besides varying in the individual, also varied in the predicate (being present vs. being absent). A third reason is that splitting the set of all broadly relevant propositions into a negative and a positive QUD is a perfectly ordinary type of discourse strategy (Roberts, 2012), and one which has certain important advantages in its own right (Westera, 2017c), primarily that it prevents the symmetry problem from arising, thus enabling communicating a large part of the answer implicitly via exhaustivity implicature.

It is also important to note that Assumption D. is perfectly compatible with the observation in Leech (1983) and Horn (1989) that our primary interests are in fact generally asymmetrical, i.e., that we tend to be interested primarily in what the world is like, not in what the world is not like. This is because even if negative information is not relevant for its own sake, it will still be relevant for secondary reasons. To see how, suppose we are primarily interested in establishing the truth of a proposition $p$ but not its falsity, i.e., establishing the truth of a proposition but not its falsity directly helps us achieve our extra-linguistic goals. In this case, even the falsity of $p$ is still worth establishing, because it would inform us that the discourse goal of establishing
$p$ can no longer be achieved, and prompt us to find alternative routes to achieving our extra-linguistic goals. That is, the negations of relevant propositions are generally themselves worth establishing, not for their own sake, but because they help us prune the set of achievable goals and change our strategy accordingly. As Horn (1989) observes, the reason for sharing negative information tends to consist in the earlier consideration of its positive counterpart. Since according to this view positive and negative information tend to be relevant for very different reasons, it is natural to assume that they tend to end up in different QUDs. The fact that in the case of exhaustivity it is often the positive QUD that is explicitly addressed, aligns with the fact that we use the most prominent, most explicit intent of our utterance to address the main QUD, and less prominent intents such as implicatures to address a secondary QUD (cf. Westera, 2019).

The foregoing motivation for Assumption D., in terms of pruning unachievable goals, gives us access to a more intuitive explanation of the contrast in (1a,b), i.e., a more intuitive back-story to what the above, more formal argumentation already shows. Whenever $p$ is worth sharing, $\neg p$ is also worth sharing, not necessarily for its own sake but at the very least to prune the prior QUD in order to keep the conversational goals tidy. Since (1a) is a declarative, it serves to address a prior QUD, hence its exhaustivity implication may serve to prune it, thus be relevant and hence be intentionally communicated. By contrast, (1b) introduces a new QUD, hence there is no prior QUD in need of pruning, and the exhaustivity cannot be part of what is meant.

Assumption D. is a general assumption about the structure of relevance, not about the QUDs that subdivide it. By contrast, Assumption E. is a general assumption about QUDs:

**E. Closure:** QUDs are by default assumed to be closed under conjunction (e.g., Schulz and Van Rooij, 2006; Spector, 2007); this can be overruled by context and by other principles such as assumption G. below.

The proposed account relies on this assumption to derive that, in the case of a disjunction whose disjuncts are each relevant, ‘both’ is relevant too, unless there is a reason why it is not. In the case of assertions such as (1a) there is typically no such reason (though see (8)), hence ‘both’ is assumed to be relevant, leading to exhaustivity as the exclusion of a relevant alternative to which no attention was drawn. By contrast, in the case of questions such as (1a) there typically is such a reason (though see (9)), in which case Assumption E. serves merely to imply the existence of that reason, e.g., that the speaker introducing the QUD did not consider ‘both’ possible.

Default closure of QUDs under conjunction follows from a number of factors combined. First, if establishing the proposition $p$ is a discourse goal, and establishing the proposition $q$ is another discourse goal, then establishing their conjunction is a good way to achieve those goals (this shows why closure under disjunction would not be as plausible: The disjunction of two relevant propositions may not be informative enough to be of any use). Second, if for each of two (logically independent) propositions the goal of making it common ground is considered achievable, then by default the same is assumed for making their conjunction common ground – this is the part of Assumption E. that fails in (1b), and the reason why ‘both’ is not relevant in that case. Third, if two propositions each share a certain subject matter or discursive function by virtue of which they end up in the same QUD, then so does their conjunction.

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Well-known examples of implicature in the literature often reverse this – such as implicating “do not hire this person” by asserting something obviously irrelevant about handwriting – which is why these are often a bit funny.
An apparent counterexample to the first assumption is a case where the two goals are not independent, e.g., where establishing $p$ is only a goal as long as $q$ has not been established yet and vice versa. This would be an instance of the phenomenon know as “mention some” contexts, where giving some answer is sufficient. It is only an apparent counterexample, because it is a case where establishing $p$ plain and simple is in fact not a discourse goal, and neither is establishing $q$. Rather, there is a single goal: to establish either one of $p$ and $q$, say, the one that is easiest to establish (or even an arbitrary one). Accordingly, contrary to appearance the QUD should be represented not as a set containing both $p$ and $q$, but as a singleton set containing an (underspecified) proposition, namely the proposition that among $p$ and $q$ is easiest to establish. The formalism used in Westera (2017b) to represent QUDs can handle such cases.

Assumption E. plays a role in case of disjunctions and their ‘not both’ implication, where it crucially relates the relevance of the disjuncts to that of their conjunction ‘both’. For the account to generalize to other kinds of exhaustivity implications Assumption E. would have to be generalized. For instance, for the account to handle cases where “some” implies “not all”, one would need to add the assumption that, by default, if the proposition expressed by means of “some” is relevant then so is the proposition expressed by means of “all” – this is essentially the common assumption that “some” and “all” form a ‘scale’ (Horn, 1972; Geurts, 2011). The robustness of this type of assumption to exceptions will be different for the various possible triggers of exhaustivity (e.g., there are uses of “some” where replacing it by “all” would not make for a relevant contribution at all), and the robustness of predictions of the account will vary accordingly.

5.3. Assumptions F. & G.: Asking questions

The account relies on two fairly minimal assumptions about questions, the first about the difference between questions and assertions that is ultimately responsible for the contrast in (1):

**F. Table:** Interrogatives normally serve to introduce a new QUD to the table, while declaratives presuppose (accommodatably) a pre-existing QUD (Farkas and Bruce, 2010).

As I meant to show with examples (8) and (9), Assumption F. is again a type of default assumption, permissive of exceptions with the predictions of the account changing accordingly.

Assumption F. predicts that someone who utters an interrogative is responsible for the choice of QUD in a way that someone who utters a declarative is not. Assumption G. in turn spells out one consequence of this responsibility:

**G. Possibility:** A speaker who introduces a new QUD to the table should consider all propositions it contains possible.

Roberts captures this in her definition of “QUD” (2012, p.14), and the first half reappears in her “Pragmatics of Questions” (p.22), but this assumption generalizes beyond the notion of QUDs in communication to goals more generally: One should not set new goals if one already knows that these are unachievable. The same idea occurs in Cohen and Levesque’s (1990) formal theory of goals (their “realism” constraint, p.227).

For the present account, Assumption G. serves to effectively weaken Assumption E. of closure under conjunction, to closure under conjunction as far as these conjunctions are considered possible. This entails for the disjunctive question in (1b) that the reason for not including ‘both’
in the QUD is that the speaker must not consider it possible, which is how the exhaustivity implication ‘not both’ of (1b) is derived. (By contrast, for (1a) the ‘not both’ implication followed more directly from the relevance of ‘both’ and the A-maxims.)

Strictly speaking, Assumption G. is a bit too weak (and accordingly Assumption E., which Assumption G. in turn is supposed to weaken, is a bit too strong). One should consider possible not just the propositions in a QUD themselves, but also their being made common ground, which is not the same. After all, a proposition can be considered possible even if making it common ground is considered unachievable, namely, if it is known that no one knows whether the proposition is in fact true. Strengthening Assumption G. in this way would subtly change the predictions of the account: The question in (1b) would primarily imply that the speaker considers the goal of making ‘both’ common ground unachievable, not necessarily that they believe that ‘both’ is false. In Westera (2017b) I explore certain consequences of this nuance, and show that the following assumption could be added to strengthen this prediction: that speakers tend to introduce only QUDs for which they consider it at least possible that each of their propositions will be completely resolved (affirmed or negated).

5.4. Assumptions H. & I.: Prosody

A crucial ingredient of the account is that the utterances are taken to comply with the maxims. Compliance with the I-maxims is needed to justify the assumption that the information that is both taken to be true and relevant is part of what the speaker meant. Compliance with the A-maxims is required to derive the exhaustivity implication ‘not both’ to begin with (in particular the maxim of A-Quantity), where the A-maxims (unlike the I-maxims) crucially apply to questions as well as assertions. Compliance with the maxims is often simply assumed as the starting point of pragmatic explanations, but this is justified only in systems where compliance with the maxims is always possible (i.e., where they are defined in such a way that they never clash). The current definition of the maxims does permit clashes, however, and this means that compliance with the maxims cannot simply be taken for granted.7

A solution to this puzzle is to assume that speakers themselves indicate the status of the maxims. Indeed, my theory of Intonational Compliance Marking (Westera, 2013, 2017b) entails that speakers of English use prosody, in particular right boundary tones H% and L%, to indicate whether they believe all the maxims are complied with relative to the main QUD. For present purposes what matters are the low boundary tones:

I. **Low boundary tones (L%)**: The L%, as in both (1a,b), indicates that the utterance is intended to comply with all the conversational maxims as far as the main QUD goes.

My dissertation (Westera, 2017b) presents the Intonational Compliance Marking theory in detail. But the core idea that rises and falls indicate non-compliance and compliance with the maxims is essentially just a way of making existing characterizations in the literature more precise: characterizations of rises/falls as indicating the pragmatic incompleteness/completeness of an utterance (e.g., Bolinger, 1982; Pierrehumbert and Hirschberg, 1990; Bartels, 1999).

If instead the maxims were to be redefined to avoid clashes, they would be either too restrictive and too often prevent speakers from making a contribution, or they would be too weak to be able to deliver exhaustivity.
A known feature of QUDs is that their shape is reflected, in English and many other languages, by prosodic focus (Beaver and Clark, 2009). Assumption H. captures one aspect of this:

**H. Disjunction:** ‘Contrastive’ focus intonation on the disjuncts, as intended in (1a,b), indicates that the QUD is supposed to contain the individual disjuncts.

This assumption (shared by, e.g., Biezma and Rawlins, 2012) can in fact be derived from a standard view on focus: Focus intonation on the two disjuncts is compatible either with (a QUD paraphrasable as) a single-wh question “Who was at the party?”, or with a disjunctive multi-wh question “Who was at the party or who was at the party?”. The latter is a rather strange creature; it would make sense only in certain very specific contexts, e.g., as an echo question, or with a different implicit domain restriction for each disjunct. In the absence of the contextual factors required for this more specialized interpretation, the default interpretation of a disjunction with focus on both disjuncts will therefore be the first one, which corresponds to Assumption H.

Note that Assumption H. is phrased rather cautiously: The QUD is supposed to contain the disjuncts. This is because it is possible for a speaker to be uncertain about what the QUD is. In the derivations in section 4 I went from their supposed relevance (Assumption H.) to their actual relevance in a single step by appealing to compliance with the maxims (Assumption I.), glossing over the following derivation. First, the speaker must have intended to draw attention either to the two disjuncts, or only to the disjunction as a whole – the form of the utterance does not fully determine this. Then, from the supposed relevance of the disjuncts we can conclude, through compliance with the maxim of A-Quantity, that the speaker must have intended to draw attention to them (even mere possible relevance is enough for A-Quantity to demand that attention be drawn to it). Lastly, from the latter, combined with compliance with the maxim of A-Relation (to draw attention only to things that are relevant), we can conclude that the speaker must consider the two disjuncts to be indeed relevant.

Details like the latter may seem excessive – it is tempting to just take for granted that the disjuncts are relevant, or that the disjunction is used with the intention of drawing attention to the them – but these simplifications would result in false predictions even for subtly different utterances, e.g., disjunctions with a single, ‘broad’ focus or disjunctions with a final rise (H%).

6. Conclusion

In a nutshell, the implication “not both” is part of what is meant for declaratives but not interrogatives, because its positive counterpart “both” is part of the QUD for declaratives but not interrogatives. This solves a long-standing puzzle, one which is challenging for predominant pragmatic and grammatical approaches to exhaustivity, through the interaction of general pragmatic principles. It highlights that to derive an implication and to explain its being part or not being part of what is meant are two separate issues, the latter of which has been unduly neglected.

References


A closer look at scalar diversity using contextualized semantic similarity

Matthijs WESTERA — Universitat Pompeu Fabra
Gemma BOLEDA — Universitat Pompeu Fabra / ICREA

Abstract. We take a closer look at van Tiel et al.’s (2016) experimental results on diversity in scalar inference rates. In contrast to their finding that semantic similarity had no significant effect on scalar inference rates, we show that a sufficiently fine-grained notion of semantic similarity does have an effect: the more similar the two terms on a scale, the lower the scalar inference rate. Moreover, we show that a context-sensitive notion of semantic similarity (in particular ELMo; Peters et al., 2018) can explain more of the variance in the data, but only modestly, only for stimuli that contain informative context words, and only when the scalar terms themselves are sufficiently context-sensitive.

Keywords: scalar inference, scalar diversity, semantic similarity, relevance, distributional semantics, context.

1. Introduction

Scalar inference is the phenomenon whereby asserting a weaker proposition can warrant inferring the negation of certain stronger alternatives. To illustrate:

(1) a. It is warm. \(\sim\) It is not hot.
b. The boy dislikes broccoli. \(\sim\) The boy doesn’t loathe broccoli.
c. The teacher believes it is true. \(\sim\) The teacher doesn’t know that it is true.
d. The nurse saw some of the signs. \(\sim\) The nurse didn’t see all of the signs.

When considering different words and constructions, the rate at which scalar inferences are drawn can vary greatly (Doran et al., 2009; van Tiel et al., 2016; Gotzner et al., 2018). Van Tiel et al. (2016) demonstrate such ‘scalar diversity’ experimentally with stimuli such as the following, asking participants for binary answers (Yes/No):

(2) John says: “The sand is warm”. Would you conclude from this that, according to John, the sand is not hot?

They tested 43 weaker/stronger word pairs in this way, including those in (1), i.e., warm/hot, dislike/loathe, believe/know, and some/all. See figure 1 for all the word pairs they tested – most of them are adjectives, four pairs are closed-class items (some/all, may/will, may/have to, and few/none). Van Tiel et al.’s results across these various pairs comprised basically the full range between 0% and 100% of participants choosing Yes.

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Figure 1: Figure taken from van Tiel et al. 2016: the percentage of participants responding “yes” for each item, in Experiment 1 (gray) and Experiment 2 (orange).
The aim of this paper is to contribute to explaining the scalar diversity in van Tiel et al.’s data, by taking a closer look at the role of semantic similarity in the results. Van Tiel et al. note that semantic similarity ought to play a role in explaining scalar diversity, but they find no effect. In line with observations by McNally (2017), we suspect that a more fine-grained notion of semantic similarity than the one considered by van Tiel et al. might do a better job. More precisely, the notion of semantic similarity used by van Tiel et al. (Latent Semantic Analysis; LSA; Landauer and Dumais, 1997a) is context-independent: it assigns the same number to a pair of words (representing their similarity) regardless of the context in which they occur. Because as McNally notes context may matter in various ways, we investigate whether perhaps a context-sensitive notion of semantic similarity, obtained from the more recent ELMo model (Embeddings from Language Models; Peters et al., 2018), could do a better job at explaining scalar diversity.

2. Background

2.1. Scalar inference

Different accounts exist of what causes scalar inferences to arise. A common explanation is pursued in the so-called neo-Gricean approach (see Geurts, 2011 for a critical but ultimately favorable discussion): if the speaker in each of the examples in (1) had believed the stronger proposition, they would have asserted that instead – since they did not, they must believe it is false. Another is pursued in the so-called grammatical approach: the weaker and the stronger proposition stand in a certain grammatical relationship that guarantees that the statements in (1) (on the left of the \( \Rightarrow \)) are ambiguous between a reading with and a reading without the scalar inference, and when facing ambiguity we would simply choose the strongest interpretation. A more recent proposal is attentional pragmatics (Westera, 2017), which maintains that scalar inference arises not from stronger alternatives not being asserted, but from them not even being mentioned (see also Westera, 2020 in this volume).

The discussion in van Tiel et al. (2016) are grounded primarily in the neo-Gricean approach, but not in a way that restricts their conclusions (or ours in the present paper) to that branch. All approaches to scalar inference are compatible in principle with scalar diversity as observed in van Tiel et al. (2016), though some more explicitly so than others. For one, each approach in principle permits the existence of many other pathways to scalar inference (Geurts, 2011), e.g., lexical semantics, typicality inference, and various pragmatic routes. Moreover, even within the pathways favored by each approach there exist parameters representing contextual relevance, lexical knowledge and general world knowledge, each of which can influence the degree to which a scalar inference is predicted for a given example. Though while each theory permits scalar diversity, explaining it is another matter: contextual relevance, lexical knowledge and general world knowledge are each notoriously difficult to model in their own right.

2.2. Van Tiel et al. (2016): Scalar diversity

Van Tiel et al. (2016) show experimentally that the perceived presence of scalar inferences varies greatly between different scales (see also Doran et al.; Gotzner et al., 2009; 2018), with stimuli such as the following for the scale warm/hot:

(3) John says: “That is warm”. Would you conclude from this that, according to John, it is not hot? Yes/No.
They perform two experiments with 25/30 participants each, each with the same 43 pairs of words, such as warm/hot, adequate/good and believe/know. In Experiment 1 the context words in the stimuli are minimally informative, containing pronouns such as “that” in (4), whereas Experiment 2 contains more descriptive context words, e.g., “this sand” in (4):

(4) John says: “The sand is warm”. Would you conclude from this that, according to John, the sand is not hot? Yes/No.

The context words van Tiel et al. used in Experiment 2 were obtained experimentally by asking 10 participants to fill in the blanks in sentences such as the following:

(5) The ______ is warm but it isn’t hot.

From the resulting 10 candidate expressions per item, van Tiel et al. selected 3 expressions for each item based on two constraints: try to select two frequent and one infrequent choice, and try to ensure some diversity in the range of expressions. The three selected expressions for each item were used as context words in the stimuli in Experiment 2. For the item warm/hot:

(6) a. The weather is warm. b. The sand is warm. c. The soup is warm.

Van Tiel et al.’s results in both Experiment 1 and 2 comprised essentially the full range between none and all of the participants choosing yes. This is shown in figure 1. Van Tiel et al. report that, overall, the rates of “yes” responses did not differ significantly between the two experiments, and that there was no pair of stimuli for any scale that differed significantly in this regard, either. Van Tiel et al. consider two broad factors for explaining the variation in scalar inference they find: availability of the stronger item on the scale as a relevant alternative, and distinctness of the two items on the scale.

The availability of the stronger term as a relevant alternative conceivably affects scalar inference because, according to most theories, scalar inference is the exclusion of relevant alternatives. If the stronger term on a scale is not in fact a relative alternative, then the reason why the speaker did not use it is that it is irrelevant, not that it is false. This is conceivably the case for the scale participate/win (though this is not the explanation we think the data ultimately favors): upon hearing (7) one may not normally guess that the question of whether she won was likewise relevant – perhaps the question of participation and the question of winning are normally considered one at a time:

(7) She participated. (∗ she didn’t win)

The unavailability of “she won” as a relevant alternative could explain the low rate of scalar inference for this scale. More generally, the expectation is that the more readily available the stronger term is as a relevant alternative, the higher is the rate of scalar inference.

The other factor, distinctness, conceivably affects scalar inference because if the two terms on the scale are insufficiently distinct, then the speaker’s choice for one rather than the other may well be arbitrary (for present purposes) or due to imprecision. In that case one cannot conclude from the speaker’s use of the weaker term the negation of the stronger term. Perhaps
this is illustrated by the scale *special/unique*, since the types of contexts where the difference between these would matter (i.e., contexts where one could reasonably say “It is special, but not unique”) seem to us quite atypical:

(8) It is special. (∴ it isn’t unique)

Thus, if the weaker and the stronger term are not relevantly distinct, one expects a lower rate of scalar inference. Availability and distinctness are in a way opposite forces: the two terms on a scale should be related (lest the stronger one will not be available as a relevant alternative), but not too similar (lest the difference between them be irrelevant or negligible).

Van Tiel et al. consider a number of variables which they suspect may correlate with availability and distinctness. We refer to van Tiel et al.’s own discussion of these factors as well as the discussion in McNally (2017), and concentrate here on only one factor: *semantic similarity*, which they take from the distributional semantic approach Latent Semantic Analysis (LSA; Landauer and Dumais, 1997b; see below). Van Tiel et al. consider semantic similarity primarily as a measure of availability: for the stronger term to be readily available as a relevant alternative to the weaker term, the two terms must tend to be relevant in similar contexts, which means they tend to be used in similar contexts – and words with similar contexts of use are assigned similar semantic representations in distributional semantics (see section 2.4). However, we think semantic similarity should also correlate (inversely) with distinctness: the more semantically similar the two terms on a scale, the less distinct they are.

The expectation for scalar inference in general is that words must be similar (lest the stronger term not be available as a relevant alternative) but not too similar (lest they be insufficiently distinct for the difference between them to matter). Contrary to expectation, van Tiel et al. find no evidence for this hypothesis; they find no effect of semantic similarity. It seems unlikely that the positive and negative effects of semantic similarity would exactly cancel each other out (and there are reasons to believe only one of the two factors is active anyway; see section 6). So why do they not find any effect? The aim of the present paper is to understand this better, and in particular to see whether this reflects a shortcoming of the notion of semantic similarity used and whether a better notion exists for which the data do show an effect.

2.3. McNally (2017): Context matters

Our aim to understand the absence of an effect of semantic similarity in van Tiel et al.’s data is shared by McNally (2017). McNally notes that the notion of semantic similarity used by van Tiel et al. (based on a particular distributional semantic model, see section 2.4) is rather coarse-grained. More precisely, it is context-independent, in the sense that the same vector is assigned to a word regardless of the sentence in which it occurs. Accordingly, it may not do justice to the particular senses with which the terms are used in their experiment. As McNally notes (p.5), “though *warm* and *hot* are scalemates for ascribing temperature, *hot*, but not *warm*, is used for popularity (*a hot/??warm* product), temper, and sex appeal (*a hot/??warm* body); while *warm*, but not *hot*, is used for friendliness or empathy (*a warm/??hot* personality).” As a consequence, the overall semantic similarity of the two terms *warm* and *hot* will underestimate their actual similarity in the temperature ascriptions that comprise van Tiel et al.’s stimuli.

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 Besides context narrowing down the sense in which both terms of a scale are used, thereby rendering the scalar inference rate higher than one would expect on the basis of a context-independent notion of semantic similarity, context can in principle also favor interpreting the two terms of a scale in two different senses, leading to a lower scalar inference rate. For instance, McNally suggests that (9) may have a low scalar inference rate because the adequacy/goodness of one’s salary can be assessed in different ways:

(9) The salary is adequate. (≠ the salary is not good)

Participants in van Tiel et al.’s experiment were free to interpret “adequate” in one way (e.g., as meeting one’s needs) and “good” in another (e.g., being better off than one’s peers), which strike us as reasonable interpretations. But because the goodness of one’s salary compared to peers is a separate question from its adequacy in meeting one’s needs, under this interpretation “good” (in the sense of compared to peers) is not available as a relevant alternative to “adequate” (in the sense of meeting one’s needs). Accordingly, participants who favored this interpretation would report no scalar inference.

Context can also affect the availability of a relevant alternative by modulating expectations of relevance itself (i.e., not just by favoring particular senses for the two terms, as in (9)). McNally suggests that (10a) may imply “not hot” because hot sand can be dangerous and hence relevant, whereas (10b) may lack this implication because it may well be used instead to contrast warm (and hot) soups with cold soups instead:

(10) a. The sand is warm. (≠ the sand is not hot)
b. The soup is warm. (≠ the soup is not hot)

These and the foregoing examples are mere illustrations of how context could in principle influence scalar inference. As it turns out, in van Tiel et al.’s data, example (9) indeed seems to behave in the way suggested by McNally, but (10) does not – but these particular examples do not really matter for present purposes: the main point, that there are ways for context to influence scalar inference, holds regardless. We agree with McNally (and, e.g., Geurts (2011), whom she notes holds a similar view) that it is important in general not to loose track of the ways in which context, lexical knowledge and world knowledge can affect phenomena such as scalar inference. The more immediate takeaway for present purposes is that a context-independent notion of semantic similarity, such as that used by van Tiel et al., may be too coarse-grained to adequately model effects of semantic similarity (availability, distinctness) on scalar inference.

2.4. Semantic similarity

The notion of semantic similarity considered by van Tiel et al. (2016), as well as the additional notions we will consider in this paper, are derived from distributional semantics. Distributional semantics is based on the ‘distributional hypothesis’ (Harris, 1954), which states that words with similar meanings are used in similar kinds of contexts (i.e., have similar distributions). In distributional semantics, the meaning of a word is represented as a high-dimensional numerical vector, derived by abstracting over occurrences of the word in large amounts of data.
Figure 2: Schematic representation of the ELMo model (Embeddings from Language Models) applied to the sentence “the sand is warm”.

These vector representations have been shown to correlate with many aspects of word meaning, and they have been successfully used as models of semantic similarity in cognitive science and computational linguistics (for overviews see Clark (2015); Lenci (2018); Boleda (2020)). Semantic similarity between two words is computed as the cosine of the angle between their vectors: the cosine is 0 when the vectors are exactly orthogonal, 1 when they point in the same direction, and -1 when they point in opposite directions.

Traditional ‘count-based’ methods of distributional semantics start from a (huge) table of word-context occurrence counts and apply dimensionality reduction to derive the word vectors. More recent ‘prediction-based’ methods instead start from random word vectors (typically the weights in an artificial neural network) and incrementally update them to better predict word-context occurrences (for a comparison see Baroni et al., 2014). Van Tiel et al. (2016) obtained their notion of semantic similarity from an influential count-based model: Latent Semantic Analysis (LSA; Landauer and Dumais, 1997b), in particular the model referred to as “General Reading up to 1st year college” available at http://lsa.colorado.edu. In this paper we will compare this notion of semantic similarity to notions obtained from three alternative distributional semantic models: the count-based model GloVe (Global Vectors; Pennington et al., 2014), and the prediction-based models Word2Vec (Mikolov et al., 2013) and ELMo (Embeddings from Language Models; Peters et al., 2018).

Standard distributional semantic models (both count-based and prediction-based), including LSA, Word2Vec and GloVe, assign a single vector to each word in the vocabulary. These models do not come equipped with a systematic method for ‘contextualizing’ these representations, i.e., for assigning (slightly) different vectors to the same word in different contexts, vectors which could represent the particular ‘sense’ in which the word is used in that context. ELMo’s main innovation, and the engine behind its enormous success on many NLP tasks, is that it does come with such a method. Because the resulting context-dependence of its vector representations is crucial for present purposes we will briefly summarize how this works. We will not summarize the other models: we include LSA merely as a sanity check (i.e., comparison to van Tiel et al.’s results), GloVe merely as a more recent representative of the count-based models of which LSA is also a specimen, and Word2vec because it was effectively the state-of-the-art in neural network models of distributional semantics prior to ELMo.

ELMo is a neural network model, schematically depicted in figure 2. It takes as input a sentence (in the figure “the sand is warm”), one word at a time, and is trained on the task of predicting
the next word at every step. The part relevant for present purposes can be broken up into two sub-models which traverse the sentence in opposite directions (to account for the fact that the contextualized meaning of a word can depend both on what comes before and on what comes after). Each sub-model consists of three layers. The first layer (in fact shared between both sub-models) assigns a context-independent vector representation to each word in the vocabulary, comparable to those of the other models of distributional semantics. In the next two layers these representations are iteratively combined with a vector representation of the context (from the left or from the right), using a recurrent neural network of the influential Long Short-Term Memory type (LSTM; Hochreiter and Schmidhuber, 1997). The contextualized representation of a word computed by ELMo at a given layer is the concatenation of its representations in the forward and backward sub-models at that layer. Normally, the contextualized representations used for downstream tasks are computed as weighted averages of the three layers (but see below).

3. Approach

In the previous section we reviewed why semantic similarity is expected to have an effect – positive (availability) or negative (distinctness) – but also why an appropriate notion of semantic similarity should be context-sensitive. To test whether this expectation is borne out we fit a number of logistic regression models on the data from van Tiel et al. (2016) (the individual responses). Each model is fitted to predict the yes/no responses as the dependent variable, based on a notion of semantic similarity as independent variable, where different models use different notions of semantic similarity: some context-independent and some context-dependent. We compare models by considering both the percentage of variance they explain (pseudo-$R^2$) and the effect size ($\beta$).\footnote{We fit logit models using Python’s \texttt{statsmodels} package (Seabold and Perktold, 2010).} We do this for the data from van Tiel et al.’s Experiments 1 and 2 separately, in order to see whether the different degrees of contextualization in their respective stimuli has an effect.

We consider six notions of semantic similarity. Each is computed as the cosine similarity between vector representations of words, where the vector representations come from different distributional semantic models as described in the previous section:

- **LSA**: the classical, count-based distributional semantic model used by van Tiel et al., for which they found no effect;
- **GloVe**: A more recent, count-based distributional semantic model, whose representations are likewise context-independent;
- **Word2vec**: An influential neural-network based distributional semantic model, whose representations however are still context-independent;
- **ELMo0**: The first word embedding layer of ELMo, which is context-independent;
- **ELMo1**: The second layer of ELMo (the first layers of its recurrent modules, concatenated), which is context-dependent;
- **ELMo2**: The third layer of ELMo (the second layers of its recurrent modules, concatenated), which is likewise context-dependent.
For LSA, GloVe, Word2vec and ELMo0, obtaining the word representations for the terms in each scale (on which then to compute cosine similarity) is a matter of looking them up in each model’s list of word representations. For ELMo1 and ELMo2 the model is instead given the whole stimulus sentence (e.g., “the sand is warm”) after which the representation of the scalar term “warm” in the two layers of the recurrent module is extracted. Thus, whereas from the context-independent models we obtain one number per scale representing the semantic similarity of the scalemates (e.g., one number for warm/hot), and likewise for the first layer of ELMo, from the context-dependent ELMo layers ELMo1 and ELMo2 we obtain one number per sentential stimulus, i.e., four numbers per scale (one from Experiment 1 and three from Experiment 2). For instance, for the scale warm/hot we get one number for it is warm/it is hot from Experiment 1, another for the sand is warm/the sand is hot from Experiment 2, and two more numbers for variants of the latter. See table 3 for concreteness.

Strictly speaking, extracting the individual layers of ELMo and using them separately is not how ELMo is normally used, or how it was intended. Normally one would use a weighted sum of the three layers, where the weights are finetuned to a particular task. The idea behind this is that different layers will likely encode different kinds of information about the word – and indeed, Aina et al. (2019) show that whereas the ELMo1 representations are still strongly based in the current word, the ELMo2 representations contain more information about the next word (i.e., the word to be predicted by the model during training) – which makes sense given the task on which ELMo is trained (see again figure 2). We did fit a model of this kind (i.e., with all three layers as independent variables) but found no real improvement in $R^2$ over the models using just ELMo1 (moreover, because the number of scales used in van Tiel et al. (2016) is quite small (43) we fear the added parameters of this approach increase the risk of overfitting). Accordingly, below we will report only the results of the models based on individual ELMo layers. Note that such a within-ELMo comparison is interesting for the current research question in its own right, given the different degrees of ‘contextualization’ in the different layers (Aina et al., 2019).

4. Results

Figure 3 shows the percentage of the variance explained (pseudo-$R^2$) by each of the fitted models. It reveals that the context-independent models LSA, word2vec and Glove capture hardly any of the variance in the data, in line with the findings of van Tiel et al. (2016). The ELMo models fit the data better, explaining up to 6% of the variance in Experiment 1 and up to 4% in Experiment 2. Among the ELMo models, on Experiment 1 the context-independent model ELMo0 is best, followed by the context-dependent models ELMo1 and ELMo2; on Experiment 2, context-dependent ELMo1 takes the lead.
Figure 3: Percentage of variance explained (Pseudo-$R^2$) by the fitted models.

Figure 4: Coefficients of the fitted models.

Figure 4 shows the coefficients of the fitted models. The similarity scores were normalized prior to model fitting (divided by standard deviation), so the exponentials’ coefficients are interpretable as the expected change in the odds of a “yes” response (i.e., a scalar inference) if the similarity is increased by one standard deviation. The plot shows bigger (negative) effects for the ELMo models, with, e.g., in Experiment 2, increasing the ELMo1-similarity by one standard deviation yields around a 40% $(1 - e^{-0.5})$ decrease in the odds of a “yes” response. For LSA the effect seems considerable as well, though in the opposite direction – but recall that it explains much less of the data. Word2vec and GloVe have hardly any effect, suggesting that the worse performance of the LSA model compared to the ELMo models is not due to LSA simply being an older model or due to it not being a neural network model. Among the ELMo models, the coefficients show the same ranking as the $R^2$ in figure 3: on Experiment 1 the context-independent layer ELMo0 has the largest effect, followed by ELMo1 and ELMo2; on Experiment 2, context-dependent ELMo1 takes the lead.

We noticed that ELMo assigns considerably lower similarities to the four closed-class items
Figure 5: Percentage of variance explained (Pseudo-$R^2$) by the fitted models, restricted to the 39 open-class items.

Figure 6: Coefficients of the fitted models, restricted to the 39 open-class items.

compared to the open-class items (mostly adjectives): *some/all, may/will, may/have to, and few/none*. Since these items are also more likely to trigger a scalar inference, that could explain why semantic similarity in the ELMo models has a negative effect – perhaps these items dominate the data. To find out whether the effect persists also within the (more uniform) subset of open-class items, we fitted the same models on just those (39 out of 43 items). Figures 5 and 6 show the pseudo-$R^2$ and coefficients of the resulting models. Figure 5 reveals that a substantial portion of the variance explained by the original ELMo models for all items (compared to Figure 3) must have been due to the closed-class items: on the open-class items pseudo-$R^2$ drops to a mere 1.5%. Another striking difference compared to the earlier figures is that, on the open-class items, Word2vec is somehow doing a lot better in Experiment 1 (though still not in Experiment 2). Besides these differences the same crucial pattern is visible among the ELMo models: in Experiment 1 context-dependence appears not to make a difference (ELMo0 and ELMo1 perform alike) while in Experiment 2 it does, with ELMo1 being the winner, even by a slightly larger margin than before, reflecting perhaps that the open-class items are more
context-dependent than the closed-class items.

5. Discussion

Let us explore some possible explanations for the foregoing observations, some more speculative than others, and all in need of further investigation.

The ranking of the models (in terms of variance explained, i.e., figures 3 and 5) suggests that the ELMo models provide the best word representations for predicting an effect of semantic similarity on scalar inference, regardless of the hypothesized effect of context: the context-independent ELMo0 model performs better (Experiment 1) or almost as well (Experiment 2), after all. We initially thought that the general superiority of ELMo could reflect its better grasp on closed-class items (function words), and this is certainly true compared to Word2Vec, which improves to almost the level of ELMo when considering only open-class items (figure 5, left). Indeed, closed-class items are known to be challenging for (especially traditional) distributional semantic models, which have tended to focus on open-class items from the outset both in training and in evaluation methods. But LSA and GloVe do not improve when considering only the open-class items, suggesting that there is something else at play, too.

A potentially relevant difference between the four models in this regard is the context window used during training, on which they form a kind of spectrum: for LSA the context window during training is a full document, for ELMo it is a (potentially long) sentence, for Word2Vec it is a set of neighboring words, and for GloVe it is a single neighboring word. It is conceivable that the large context window of LSA makes it too coarse-grained for subtle meaning distinctions such as between the two terms on a scale: e.g., from the fact that *warm* and *hot* occur in similar documents (say, documents involving cooking, the weather, clothes) the LSA model may learn that both scalar terms relate to things having a temperature, but perhaps not their precise distance on the temperature scale. For GloVe we conjecture that it is, rather, its small context window that is the problem: it conceivably makes GloVe less able to detect meaning differences that affect not the direct neighbors of words, but only their indirect (longer-distance) neighbors – and the scalar differences in the current data may be of that kind. To illustrate, the scalar terms *hot* and *warm* may (in their temperature sense) apply to exactly the same kinds of things (soups, weather, clothes, etc.), so perhaps the subtle scalar difference between them tends to affect only more indirectly related events (such as decisions of whether to start eating, whether to go for a hike, and what to wear), events which may tend to be described in the same (part of a) sentence as the scalar term (hence detectable by ELMo and Word2Vec) but typically not within one word distance of it (hence undetectable by GloVe). This would explain why GLoVe does not improve when considering only the open-class words, despite these being the types of words that distributional semantics is traditionally supposed to be good at. The foregoing is very speculative, and there are many important differences between the various distributional semantic models that we have not mentioned, but the context window size during training is the only difference that currently strikes us as at least potentially relevant to the issue at hand.

We may tentatively extend the foregoing line of explanation in terms of context window size to the (presumed) difficulty of closed-class items for LSA, Word2Vec and GloVe (i.e., their low $R^2$ in figure 3). Concerning LSA, since closed-class items are frequent in any document, on any topic, LSA’s context of a full document makes the model too coarse-grained to tell such words apart. As for Word2Vec and GloVe, their context windows may rather be too small: it
is only in the context of an argument, i.e., at the level of sentences – the context window with which ELMo is trained – that the choice of one closed-class item over the other on the same scale (e.g., “may” instead of “will”) tends to have an effect. Summing up, the preceding two paragraphs tentatively explain why only ELMo has a grasp of closed-class items, and why even on the open-class items only ELMo and Word2Vec can handle the subtle scalar differences involved in van Tiel et al.’s data, with LSA and GloVe struggling in both respects.

Next, the ranking among the ELMo-based models (in both figure 3 and figure 5) suggests that context, to the extent that it matters at all, offers at best only a marginal improvement (ELMo1 compared to ELMo0), and only in Experiment 2. The lack of an effect in Experiment 1 may not be too surprising, given that context was not particularly informative in Experiment 1 to begin with; only Experiment 2 featured informative context words, after all. Nevertheless, it is not entirely unsurprising either: the stimuli of Experiment 1 do provide context in the form of syntactic structure, e.g., the stimuli reveal that a scalar term is used (say) predicatively as opposed to adjectivally, which should conceivably have an effect on scalar inference (e.g., because a predicate is more likely to be the information structural focus of the sentence). Assuming that van Tiel et al.’s participants did pick this up, the fact that the context-sensitive layers of ELMo do not perform better than ELMo1 in Experiment 1 suggests that the ELMo model’s word representations are not (sufficiently) affected by syntactic (plausibly information structural) context. Assuming that the problem is not ELMo itself (given its success on many NLP tasks), a plausible explanation for the latter could be that most of the scalar terms in the experiment are predominantly used predicatively anyway, such that this use would already dominate the (non-contextualized) word vector to begin with. We leave testing this conjecture to future work.

As for Experiment 2, where the stimuli contained more informative context words, what may be surprising there is how small a difference context seems to make, i.e., the small magnitude of the advantage of ELMo1 over ELMo0 (still figure 3). Again, let us assume that ELMo (given the success of ELMo on many NLP tasks) is in principle able to properly model the effect of context on the interpretation of the scalar terms. What the small magnitude of its effect then suggests is that only some of the scalar terms in the experiment were significantly context-sensitive to begin with. This is corroborated by the fact that figure 5, which considers only the open-class items, shows the same (or in fact slightly larger) absolute advantage in Experiment 2 for ELMo1 over ELMo0: since open-class items are generally more context-sensitive than closed-class items, the fact that ELMo1’s advantage over ELMo0 resides mostly there suggests that the context-sensitive layers have an advantage only for context-sensitive words – and perhaps even among the open-class items there were not enough of those for context to have a bigger effect. Related to the effect of context, note that although Word2Vec performed quite well when restricted to the open-class items (figure 5), no such boost was observed in Experiment 2. Together with the relative performance of ELMo0 vs. ELMo1 in Experiments 1 and 2, this suggests that for Experiment 1 it may be sufficient for the model to have adequate context-independent representations of the scalar terms, but that for Experiment 2 context-sensitivity is required.

Next, what might we conclude from the fact that the best models (ELMo) show a negative effect of semantic similarity (figures 4 and 6)? Recall from section 2 that van Tiel et al. (2016)
identified two possible influences on scalar inference, namely *availability* of the stronger scalar term as a relevant alternative (a positive effect), and the *distinctness* of the two scalar terms (a negative effect). Accordingly, the negative effect of our best models suggests that distinctness has a role to play in the experiment, but not availability, or at least less so. A possible explanation for this is the following. Although in general one would expect both availability and distinctness to affect the rate of scalar inference, in the scope of van Tiel et al.'s experiments perhaps only distinctness has a role to play. This is because the availability of the stronger terms as relevant alternatives may have been sufficiently fixed already by the experimental setting itself, a possibility considered also by van Tiel et al.: the experiment itself would imply the stronger term's availability as a relevant alternative, by virtue of explicitly asking participants about the scalar inference (see (3)). See Schwarz (1996) for discussion of this type of influence of experimental context on pragmatic assumptions.

Van Tiel’s experiments also contain some other tentative evidence for the foregoing explanation. Recall that the stimuli in Experiment 2 were constructed by eliciting context words from participants that fit in the type of scheme in (5), i.e., words that make a sentence affirming the weaker term and denying the stronger term a natural thing to say. If availability had played a role, one would expect that using these words instead of the uninformative context words (e.g., pronouns) in Experiment 1 would overall increase availability and thereby scalar inference. But this is not what van Tiel et al. find: overall, scalar inference rates were not significantly higher in Experiment 2 than in Experiment 1. Given the diversity of van Tiel et al.’s stimuli, it seems unlikely that the (uninformative) stimuli of Experiment 1 would all independently already happen to favor, as their most typical interpretation, one which made the scalar alternative available; it seems more plausible that this was enforced by the experimental setting itself. Moreover, van Tiel et al. report that within Experiment 2 there were no significant differences between the stimuli for a given scale, e.g., “the sand is warm” and “the soup is warm” have the same scalar inference rate (contrary to the example of McNally, 2017), even though van Tiel et al. tried to opt for some diversity in context words, pointing again towards the absence of a positive effect of context words on availability across the board.

Zooming out a little, the percentage of variance explained by the various models seems to us rather small, especially for the models fitted on the open-class items only. Since our research question is primarily about the comparison of context-independent and context-dependent notions of semantic similarity, the absolute performance of the models does not immediately matter for the purposes of this paper. However, it does raise the issue of what the current models are missing. There seem to be three main possibilities:

1. Other factors, besides distinctness (and maybe availability), affect scalar inference in van Tiel et al.’s experiments;
2. Other factors besides contextualized semantic similarity affect distinctness (and maybe availability) in van Tiel et al.’s experiments;
3. The notion of contextualized semantic similarity as we extracted it from the ELMo model is not good enough for present purposes.

Exploring items 1 and 2 would be a substantial inquiry in its own right, which we leave to future work (see the discussions in van Tiel et al., 2016 and McNally, 2017 for some suggestions).
Item 3 bears more directly on the aims of this paper, and we will briefly explore it.

Item 3 is a live possibility not just because models are never perfect (and in future work we hope to test the contextualized word representations of models that have more recently beaten ELMo on other tasks), but also because the particular way in which we employed ELMo may not be the most suitable. To understand the latter, let us distinguish three aspects of context: (i) the words used in the stimuli’s sentences besides the scalar term, (ii) the syntactic structure in which the scalar term appears (e.g., predicative vs. adjectival), and (iii) the experimental setting, where each stimulus explicitly asks whether the negation of the stronger scalar alternative can be inferred. In the way in which we applied ELMo to the stimuli, it can be sensitive to (i) and (ii), but not to (iii). To illustrate, recall that we used ELMo to compute the semantic similarity of “warm” and “hot” in the context of a sentence such as “the soup is ...”, which does not tell ELMo that these are stimuli in an experiment that explicitly relates “warm” and “hot”. To handle (iii) better, one could try to take the ELMo representations from sentences containing both scalar terms, such as “the soup is warm but not hot”, which, although deviant from the stimuli used by van Tiel et al., at least tells ELMo that the context is one where both scalar terms occur. We leave this to future work.

6. Conclusion

Scalar inference – the inferred negation of a stronger statement from the utterance of a weaker statement – is expected to depend on the semantic similarity between the stronger term and the weaker term: the two terms should be similar (lest the stronger term not be available as a relevant alternative) but not too similar (lest a speaker’s choice for one over the other be due to, e.g., imprecision instead of the negation of the stronger term). Semantic similarity in turn is expected to depend on, among other things, the precise senses in which the scalar terms are used, which can be constrained by context. To test these expectations, we analyzed the experimental results from van Tiel et al. (2016) by fitting models based on different notions of semantic similarity: context-insensitive (LSA, Word2Vec, GloVe) and context-sensitive (ELMo).

Our interpretation of the results supports three main conclusions. First, a sufficiently fine-grained notion of semantic similarity indeed affects scalar inference, and (for our best models) this effect is negative, suggesting that distinctness but not availability may have a role to play in van Tiel et al.’s experiments. Second, it appears that context-sensitivity can improve model performance, but only modestly, only when the stimuli contain informative context words (Experiment 2), and only when the scalar terms themselves are sufficiently context-sensitive (open-class items). Third, even our best models explain only around 6% (Experiment 1) and 4% (Experiment 2) of the variance in the data. The latter may reflect that even our context-sensitive models failed to take an important aspect of the context into account, namely the experimental setting itself. But it is also likely that factors other than semantic similarity play a role. In the future we hope to extend an analysis like the present one to more data and based on a more complete model of scalar inference (e.g., Gotzner et al., 2018).

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Counterfactual wishing as multiple agreement
Alexander WIMMER — Universität Tübingen

Abstract. Counterfactual (CF) wishes give rise to the well-known puzzle that CF-marking on a desire predicate leaves the desire intact (von Fintel and Iatridou 2008, 2017). German is one of the languages that exhibits this pattern. This paper takes the desire’s intactness in German CF-wishes to speak in favor of viewing said CF-marking as semantically vacuous agreement morphology. All this morphology does is to reflect CF-displacement of a silent antecedent (vF&I 2017). The morphological pattern CF-wishes seem subject to might apply to CF-conditionals more generally.

Keywords: counterfactuality, conditionals, desires, presuppositions.

1. Counterfactuality

Counterfactual (CF) conditionals like (1) typically imply their antecedent and their consequent to be false:

(1) If he were smart, he would be rich. Iatridou 2000
\[ \sim \text{he is neither smart nor rich} \]

The morphological inventory by means of which counterfactuality is conveyed varies between and even within languages. But it is safe to say that past tense morphology is frequently involved (Iatridou 2000). German CFs also fall under this pattern. What is labeled as CF in (2) is actually a past conjunctive (Konjunktiv 2).²

(2) Wenn die Sonne schiene, würden die Kirschen blühen.
\[ \text{‘If the sun shine-CF would the cherries bloom} \]
\[ \text{German} \]

There is a multitude of possible analyses for CF-conditionals, even if the object language is confined to English. It is, for example, far from settled whether counterfactual inferences are implicatures (Iatridou 2000), presuppositions (Schulz 2014) or anti-presuppositions (Leahy 2011, 2018), whether the past-morphology is temporal/’real’ (Romero 2014) or modal/’fake’³ (Iatridou 2000). In presentation slides, von Fintel & Iatridou [henceforth vF&I] (2017) even question the term counterfactual itself, at least when applied to the morphological inventory CF-inferences are based on. The present paper leaves such important questions aside, holding the somewhat simplistic view that CF-marking reflects an LF-operator CF taking a proposition

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1This paper constitutes the core of a chapter in my dissertation, but the analysis slightly deviates, see footnote 27. Among others, I am indebted to Giuliano Armenante, Nadine Bade, Sigrid Beck, Julia Braun, Vera Hohaus, Toshiko Oda, Konstantin Sachs, as well as audiences at SuB 24, CLS 54, and the doctoral colloquium (DoKo) at Tübingen’s SFB 833. The paper has benefited from reviews for both SuB and CLS, including Mingya Liu’s (SuB), and proofreading done by Lilian Gonzalez, Vera Thomas and SuB student assistants. All remaining inadequacies are, of course, my own. The initial source of inspiration for this paper is a class on the linguistics of desire co-taught by Kai von Fintel and Sabine Iatridou in the fall of 2017, which I had the chance to attend. Funding by the Deutsche Forschungsgemeinschaft (DFG) via XPRAG.de is gratefully acknowledged.

2The glossing abbreviations I am using are the following. ASP = aspectual marker, CF = counterfactual morphology [abstracting away from morphological specifics], PAST = past tense, IND = indicative mood, INF = infinitive, NOM = nominative marker.

3While Iatridou (2000)’s terminological distinction between real and fake past is not uncontroversial, it is a very handy tool of referring to the two different interpretations past morphology has the potential to give rise to.

and presupposing its falsity. The question of interest here is whether there is a 1:1-mapping between CF-marking and the CF-implications involved. An option in favor of such a morphosemantic equivalence is given in (3a): CF-marking on both the antecedent p and the consequent q is taken literally, to the effect that p and q each have a CF-operator of their own attached to them at LF. An option disfavoring said equivalence takes only CF-marking on p to be semantically contentful, and q’s implied falsity to be a defeasible by-product of what CF does to p. As a result, only p, but not also q, has a CF-operator attached to it at LF, (3b). This makes CF-marking on q semantically vacuous, and plausibly subject to agreement.

(3) a. \[ \text{[ if [ CF p ] } \] \text{CF'} q \]
\[ \leadsto \text{both p and q presupposed to be false} \]

b. \[ \text{[ if [ CF p ] ] } \text{Ø} q \]
\[ \leadsto \text{only p presupposed to be false} \]

Option 2 is supported by concessive conditionals: Both the antecedent and the consequent are CF-marked, but only the antecedent is implied to be false.\(^4\)

(4) (Even) if you were mean, I’d still be your friend
\[ \leadsto \text{you are not mean} \]
\[ \leadsto \text{I am not your friend} \]

This paper takes German CF-wishing, exemplified by (5), to favor option 2 in (3b). This is a refinement of my previous approach to CF-wishes in Wimmer (2019), where I essentially pursued option 1. German CF-wishing gives rise to a crosslinguistically attested puzzle (vF&I 2008, 2017): CF-marking on the desire verb wünschen does not deny the desire from holding, as one would expect it to do. What it does deny though is the attainability of the desideratum, as vF&I (2017) put it. This will henceforth be referred to as the disbelief-implication: The wisher is implied to disbelieve in the reality of her desideratum.\(^5\)

(5) Ich wünsch-te, [φ die Sonne scheine ].
\[ \text{I wish-CF [φ the sun shine-CF ]} \]
‘I wish the sun would shine.’
\[ \leadsto \text{absent preference for } φ \]
\[ \leadsto \text{preference for } & \text{disbelief} \text{ in } φ \]

In Wimmer (2019), I followed vF&I (2017) in taking (5) to be an implicit CF-conditional, that is, to be preceded by a silent antecedent denoting the desideratum’s doxastic possibility. While we only see the consequent clause, the silent antecedent is where the disbelief-implication is derived. This paper pushes my previous proposal one step further in that it applies option 2 in (3b) to the CF-conditional underlying (5): On this view, the visible CF-morphology is entirely vacuous, and merely agrees with a CF-operator that is a crucial ingredient to the disbelief-implication. The adequacy of option 2 in the case at hand weakly favors this option to apply to

\(^4\)The consequent is CF-marked in virtue of containing would.

\(^5\)It doesn’t take CF-marking on the complement of wünschen for this implication to arise, as it persists under infinitival complementation:

(i) Ich wünsch-te, [φ die Sonne scheinen zu sehen ].
\[ \text{I wish-CF [φ the sun shine to see-INF ]} \]
\[ \leadsto \text{preference for } & \text{disbelief} \text{ in } φ \]

This tells us that CF-marking on wünsch is in fact the only source of the disbelief-implication.
CF-conditionals more generally. The paper is structured as follows. Section 2 gives a simple semantics for wünschen. A doxastic presupposition ascribed to wünschen in section 2 will define the content of the silent antecedent. This presupposition plays a crucial role in section 3, which derives the disbelief-implication along the lines of option 2, and points out the advantages of option 2 over option 1. Section 4 concludes.

2. wünschen presupposes doxastic possibility

If wünschen appears in the indicative mood, it implies uncertainty about the truth of what is being wished for (Wimmer 2019): At least in German, there is no felicitous wishing for something held to be true or false. This can be seen when indicative wishing is put in a context that either verifies or falsifies what is being wished for. (6) is odd if uttered by the speaker (a) at the sight of her cherry tree in bloom (verifying) or (b) under the awareness that her cherry tree has perished for good (falsifying).

(6) Ich wünsch-e mir, dass mein Kirschbaum blüht.
I wish-IND myself that my cherry tree bloom
‘I wish for my cherry tree to bloom.’
$\sim$ preference for & uncertainty about cherryblooming

The oddity of indicative wishing in a verifying environment is further evidenced by the following variation of Iatridou (2000)’s I have what I want:6

(7) ?Ich habe, was ich mir wünsche.
?I have what I myself wish-IND

Gladness, by contrast, clearly implies speaker-certainty about (or belief in) the desideratum. This holds no less for German freuen, literally ‘to rejoice onself’, than for English glad (Heim 1992).

(8) Ich freue mich, dass die Kirschen blühen.
I rejoice myself that the cherries bloom
‘I am glad that the cherries are blooming.’
$\sim$ preference for & belief in cherryblooming

I take this contrast between wishing and gladness to be based on presuppositional competition between wünschen and freuen: wünschen presupposes the desideratum to be doxastically possible, and anti-presupposes the speaker to be uncertain about it, capturing the uncertainty-implication in (6). This anti-presupposition (-PSP) arises via competition with freuen.7

6Mingya Liu puts to discussion the following example’s felicity.
(i) Ich habe alles, was ich mir wünsche.
I have all what I myself wish

A sentence like (i) is allowed for under the analysis of wünschen developed below. On that analysis, uncertainty is anti-presupposed, that is, in principle suspendable. The following sounds slightly more natural to me than (i):
(ii) Ich habe alles, was ich mir nur wünschen kann.
I have all what I myself only wish can

I leave it to future research to investigate how the exclusive particle only and the possibility modal can add to a relaxation of the uncertainty-constraint indicative wishing typically comes with.

7Thinking of wünschen as presupposing the desideratum to be possible is another departure from Wimmer (2019),
The conceptual basis of anti-PSPs was laid by Heim (1991) and has since been elaborated by Sauerland (2008) and Chemla (2008), to name just a few. An anti-PSP, just like a scalar implicature (SI), is drawn if two sentences differ in, and hence compete for, propositional strength. But unlike SIs, this difference is based on truthconditional equivalence, and lies at the level of PSP. The guiding principle for an anti-PSP to be drawn is to presuppose as much as the context allows (Maximize Presupposition!). If a speaker presupposes something weaker than she could have, she thereby anti-presupposes the stronger PSP not to be met. A common illustration of presuppositional competition evokes the contrast between the definite and the indefinite article:

(9) John has interviewed {the/#a} father of the victim.
   a. +the ⇒ the victim has exactly one father
   b. +a ⇒ the victim has more than one father

How does such a competition in presuppositional strength carry over to wünschen and freuen? A crucial insight in Heim (1992) is that want, glad and wish all share the same bouletic assertion, an attitude holder x’s preference for a proposition p (the desideratum) to be true rather than false. The difference between the three predicates lies in their doxastic PSPs. The same can be reasonably assumed for wünschen and freuen. freuen, like Heim (1992)’s glad, can be taken to presuppose x’s belief in p. wünschen, by contrast, arguably presupposes x to hold p possible. This is spelled out in (10) using a diamond-operator ◇DOX,x and a box-operator □DOX,x. Both quantify over an attitude holder x’s DOXastic worlds, her belief-worlds. While the former quantifies over some of x’s doxastic worlds, the latter quantifies over all of them. Put differently, wünschen presupposes p’s doxastic possibility, freuen its necessity.

(10) \{wünschen/freuen\}(p)(x) are both true iff x prefers p rather than ¬p.
   a. wünschen(p)(x) is defined iff ◇DOX,x(p) x holds p possible
   b. freuen(p)(x) is defined iff □DOX,x(p) x believes that p

There is truthconditional equivalence between wünschen and freuen, but the latter is pre-

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8This is to ignore that the definite and the indefinite may, but don’t have to be equivalent on the level of truth conditions, Heim (2011).

9This assumption is of course subject to change in the modern world we live in.

10Mingya Liu points out the following contrast between freuen and wünschen, which I freely varied on in (i). Both sentences bring together two mutually exclusive preferences, a preference for rain and one for the absence of rain.

(i) a. Ich freue mich, wenn es regnet, aber ich freue mich auch, wenn es nicht regnet.
   I rejoice myself if it rains but I rejoice myself also if it not rains
   b. #Ich wünsche mir, dass es regnet, aber ich wünsche mir auch, dass es nicht regnet.
      #I wish myself that it rains but I wish myself also that it not rains

Why does (ib) sound contradictory, while (ia) does not? One may approach such data starting with the conditional form distinctive of (ia). The respective antecedents (if it rains and if it does not rain) are mutually exclusive themselves. This prevents the two preferences from being ascribed to the same type of situation. No such thing
suppositionally stronger than the former: necessity entails possibility. This allows the two predicates to be ranked differently on a scale of presuppositional strength, with \textit{freuen} being the stronger, \textit{wünschen} the weaker competitor.

\begin{equation}
\langle \text{wünschen}_\text{□}, \text{freuen}_\square \rangle
\end{equation}

Such a scale permits us to derive the uncertainty-implication observed for \textit{wünschen} in (6) as an anti-PSP: \textit{wünschen} anti-presupposes that the PSP of \textit{freuen}, x’s belief in \(p\), is unsatisfied. The inferred result is x’s uncertainty about \(p\): x neither believes \(p\) to be true nor to be false.\(^{11}\)

\begin{equation}
\Diamond \text{DOX}_x(p) \land \neg \Box \text{DOX}_x(p)
\end{equation}

\(p\) is possible, not necessary

\begin{equation}
\equiv \Diamond \text{DOX}_x(p) \land \Diamond \text{DOX}_x(\neg p)
\end{equation}

\(p\) and \(\neg p\) are both possible: uncertainty

The existential PSP ascribed to \textit{wünschen} in this section is going to be crucial in the next section, which derives the disbelief-implication that CF-wishing comes with. I conclude this section with a possible concern that CF-marked \textit{wünschen} may be too different from its counterpart in the indicative. As an SuB-reviewer points out, indicative and CF-\textit{wünschen} appear in slightly different syntactic environments. The indicative variant combines with a dative reflexive \textit{sich} ‘oneself’ and wants its clausal complement to be headed by \textit{dass} ‘that’, the CF-variant allows for both, but doesn’t require either.\(^{12}\)

\begin{enumerate}
\item \textit{Ich wünsche} \(?(\text{mir}), \text{dass})\) die Sonne scheint.
\item \textit{Ich wünsch-te} \(\text{mir}, \text{dass})\) die Sonne schiene.
\end{enumerate}

The existential PSP was argued for on the basis of indicative \textit{wünschen}. Given the differences that surface in (13), would it be misguided to ascribe it to CF-marked \textit{wünschen} as well? An example brought to my attention by Sarah Zobel points towards a negative answer. (14a), a line from a song,\(^{13}\) conveys a CF-wish by means of CF-marking on \textit{wollen} ‘want’. Nothing changes semantically if \textit{wollen} is replaced by \textit{wünschen} (14b).

\begin{enumerate}
\item \textit{Ich woll-t, ich wär’ ein Huhn, …}
\item \textit{Ich wünsch-t’, ich wär’ ein Huhn, …}
\end{enumerate}

\(\neg\) preference for & disbelief in being a chicken

\(^{11}\)The derivation in (12) glosses over intermediate steps of anti-presuppositional reasoning (Chemla 2008). Such reasoning minimally includes an \textit{epistemic step} that strengthens

\begin{enumerate}
\item \(x\) does not believe the PSP of \textit{freuen}(p)(x) to be met
\item \(x\) believes the PSP of \textit{freuen}(p)(x) not to be met
\end{enumerate}

This step follows automatically, see Leahy (2011) for critical discussion of an analogous case: On (10b), \textit{freuen}(p)(x) presupposes \(x\) to believe that \(p\). So (i) states \(x\) not to believe that \(x\) believes that \(p\). One cannot be in doubt about one’s beliefs. So the only possible reason for \(x\) not to believe that \(x\) believes that \(p\) is (ii): that \(x\) believes not to believe that \(p\).

\(^{12}\)Thanks to Robin Hörnig for his intuitions on (13b).

\(^{13}\)\textit{Ich wollt’, ich wär’ ein Huhn} by the Comedian Harmonists.
want plausibly implies uncertainty about whether or not the desideratum in question is satisfiable (Heim 1992, Rubinstein 2017). Above I argued that implication to be an indirect reflection of the existential PSP, which I took to compete with the universal PSP of freuen. Given the equivalence of both variants in (14), there is reason to ascribe the existential PSP to CF-marked wünschen as well.\footnote{Moreover, the wünschen-variant that CF-marking attaches to may appear in IND-settings (as old-fashioned as such sentences may sound), and then has a want-like reading. The following quote from Gottfried Keller’s 19th century novella Kleider machen Leute is a case in point.

(i) Der Herr wünscht zu speisen?
    the Sir wishes to dine.

(i) would be an odd thing to ask if the hearer were eating (verifying scenario) or if it were clear to both interlocutors that there was nothing to eat (falsifying scenario).

To be sure, vF&I’s proposal is not about CF-marked wünschen in particular, but the latter clearly falls under the phenomenon they investigate.}

3. Counterfactual wishing as multiple agreement

We noted German counterfactual (CF) wishing to come with a disbelief-implication regarding the desideratum \( \phi \), with the desire for \( \phi \) left intact.

\[(15)\] Ich wünsch-te, [\( \phi \) die Sonne schiene ]
I wish-CF [\( \phi \) the sun shine-CF ]
\( \sim \) absent preference for \( \phi \)
\( \sim \) preference for & disbelief in \( \phi \)

This section derives the disbelief-implication in pretty much the same way as I did in Wimmer (2019), where I followed vF&I (2017) in treating a sentence like (15) as an implicit CF-conditional.\footnote{I owe the italicized addition to Konstantin Sachs.} On their view, (15) is preceded by a silent antecedent, italicized in (16).

\[(16)\] (15) reads: If I held \( \phi \) possible (which I don’t), I would wish that \( \phi \)\footnote{Thanks to Eva Csipak and Chris Barker for bringing Kasper’s paper to my attention.}

Crucially, the silent antecedent accommodates the presupposition (PSP) triggered by wünschen in the overt clause. As vF&I acknowledge, accommodation of presupposed content into a silent CF-antecedent has been observed before. Kasper (1992) deals with examples such as the following:\footnote{To be sure, vF&I’s proposal is not about CF-marked wünschen in particular, but the latter clearly falls under the phenomenon they investigate.}

\[(17)\] [mother talking to her son, who failed an exam:]
Your brother Peter wouldn’t have failed the exam. Kasper (1992): 309

According to Kasper, (17) is an implicit CF-conditional whose antecedent is a PSP triggered in the overt clause. “Failing an exam presupposes having taken it” (vF&I 2017: slide 47). This PSP is what defines the interpretation of (17).

\[(18)\] Ex. (17) reads: If your brother Peter had taken the exam, he wouldn’t have failed it.

It seems that CF-wishing triggers such accommodation per default. The corresponding paraphrase in (16) implies a certain analysis, to be spelled out in what follows. In slight deviation from Wimmer (2019), the persistence of the desire under CF-marking is derived assuming multiple agreement: All the visible CF-morphology in (15) is treated as semantically vacuous,
including the one on the complement clause denoting φ. Since it is by assumption a special kind of CF-conditional we are dealing with, there is reason to hope the agreement pattern at work in (15) to apply to CF-conditionals more generally.

3.1. Spelling out von Fintel and Iatridou (2017)

Accepting the premise that (15) is an implicit CF-conditional, a follow-up question is how to analyze it. At the beginning of this paper, we’ve narrowed down our analytical options to the following two, repeated below. The first one interprets both instances of CF-morphology in a CF-conditional. The second one interprets only the first instance.

(19) a. \[ \text{if } \text{CF p } ] \text{CF}' q \] option 1
b. \[ \text{if } \text{CF p } ] \text{Ø q} \] option 2

In the following, I am going to analyze the example in (15) along option 2: At LF, there is only one CF-operator displacing the antecedent p, all the visible CF-morphology just agrees with that single CF-operator. Notice that p is silent in the case at hand; our sentence is not overtly conditionalyzed after all. It is only later that I will argue option 2 to be preferable to option 1, which I pursued in Wimmer (2019).

Following option 2 in (19b), I propose the sentence in (15) to have an LF like (20). This is only a first basic version, to be refined as we go along. The silent antecedent is a contextual variable C7, to be interpreted as the doxastic presupposition (PSP) triggered by wünschen. Ø stands for an instance of semantically vacuous CF-morphology. The fact that there are two such instances in (20) motivates my choice of the term multiple agreement.

(20) \[ \text{if } \text{CF C7 } ] \text{Ø I wish [ Ø φ ]} \]

LF for (15), first version

The disbelief-implication arises from the interplay between CF and the silent antecedent, i.e., the contextual variable C7. This variable (its numerical index 7) is assigned the doxastic PSP we ascribed to wünschen. More concretely, this is the PSP that wünschen triggers in the overt clause: existential quantification over an attitude holder x’s belief-worlds, which basically means that x holds φ possible. The overt clause’s subject is the speaker S, so S replaces x in this case.

(21) \( g(7) = \Diamond_{\text{DOX},S} (\phi) \)

The assignment in (21) is a default, if not overridden. This becomes clear when we spell out C7 as an (unintegrated) CF-antecedent. In line with (21), (22a) paraphrases the doxastic possibility of sunshine. However, such a ‘doxastic’ antecedent is not a must. (22b) may sound a little contrived, but it works, although the antecedent has nothing to do with the doxastic possibility of sunshine, i.e., 7 is assigned a value that differs from (21).

18I remain vague w.r.t. the exact nature of the agreement mechanism at play, an issue I leave to future syntactic research. Loosely following Schulz (2014), one could take CF and □ to be fused into a complex operator \( \text{CF} \). This operator could be assigned an interpretable CF-feature iCF. The visible CF-morphology on wünschen and its finite complement would then agree with \( \text{CF} \) in virtue of each carrying a matching uninterpretable CF-feature uCF.

(i) \[ \text{[CF]iCF} C7 \text{[I wish-CF]uCF} \phi \text{-CF[uCF]} \]

19With such a choice for the antecedent, the disbelief-implication is lost, and the CF-marking on wünschen behaves
(22) a. Wenn noch eine Aussicht auf Sonnenschein bestünde: Ich wünschte, die Sonne
    if still an outlook on sunshine obtain-CF I wish-CF the sun
    shine-CF
    ‘If there were still a chance (for sunshine): I’d wish for the sun to shine.’

b. Wenn die momentane Dunkelheit nicht so schön wäre: Ich wünschte, die Sonne
    if the current darkness not so nice be-CF I wish-CF the sun
    shine-CF
    ‘If I didn’t enjoy the current darkness as much as I do, I’d wish for the sun to
    shine.’

While (21) is the default interpretation of $C_7$, the $\phi$-component of (21) is subject to considerable variation. This simply depends on what is being wished for. $\phi$’s resolution may be delayed until the complement denoting $\phi$ is uttered. But $\phi$ can be discourse-salient, as in the following exchange between person A and B. This allows for an immediate resolution of $\phi$ before the complement denoting $\phi$ is uttered – if it is uttered at all. In English, the elliptical $I wish!$ suffices in such cases.\footnote{The present analysis carries over to English $wish$ under von Fintel and Iatridou (2017)’s view that $wish$ is a covertly CF-marked $want$.}

(23) a. A asks B: Do you have time? B replies:
   b. Ich wünschte, ich hätte welche.
      I wish-CF I have-CF some
      ‘I wish.’

As I further argued in Wimmer (2019), CF-wishing combines the *accommodation* with the *denial* of the doxastic PSP triggered by $wünschen$. Accommodation means that under the default interpretation of $C_7$ in (21), the LF in (20) doesn’t presuppose $\Diamond_{DOX,S}(\phi)$, which it would in absence of the silent antecedent. The point can be made with the following example from Sauerland (2008):

(24) If it was raining, John would know that it’s raining. $\not\supset$ it’s in fact raining

If the main clause weren’t preceded by the antecedent in (24), it would presuppose that it is in fact raining, given a PSP commonly ascribed to $know$. The reason that no such PSP arises in (24) is that it is locally *accommodated* (satisfied) by the antecedent.

(25) John knows that it’s raining $\nearrow$ it’s in fact raining

To show what happens in more detail, the LF in (20) needs to be refined, and its ingredients to be defined. On the wellknown Kratzerian view of conditionals, antecedent clauses restrict a universal quantifier over possible worlds, see von Fintel and Heim (2011) for an introductory discussion. This quantifier may figure as a box-operator $\Box$ at LF. So the LF in (20) can be reshaped to (26).

(26) $[\Box [\text{CF } C_7 ] ] I wish \phi$

as expected: It denies the desire from holding in the actual world. On my intuition, neither example in (22) has an exclamative flavor to it. This contrasts with regular CF-wishes whose antecedent is left silent.
The semantics of the necessity modal $\Box$ is the one commonly assumed in a Kratzerian framework. It takes two propositions $p$ and $q$, and asserts $q$ to be true in all $p$-worlds that are closest (maximally similar) to a world of evaluation $w$. This closeness-condition is a further restriction on $\Box$’s quantificational domain, and its purpose is to avoid an undesirable overgeneration of readings, cf. e.g. Heim (1992) and Iatridou (2000) on early work by Robert Stalnaker and David Lewis.

(27) $[\Box_w] (p)(q) = 1$ iff all $p$-worlds $w^*$ closest to $w$ to are $q$-worlds.

For ease of exposition, I am going to assume an obviously oversimplified semantics for the CF-operator: being truthconditionally idle, all it does is to trigger the presupposition (PSP) that its prejacent $p$ is false in $w$, the world of evaluation.

(28) $[\text{CF}_w] (p)$ is defined iff $p(w) = 0$.
If defined, then $[\text{CF}_w] (p) = 1$ iff $p(w) = 1$.

With these ingredients in place, we arrive at the final LF in (26). The antecedent and the consequent are now considered as intensions, i.e., (characteristic functions of) sets of possible worlds. The subscript @ on $\Box$ and CF indicates both of them to have the actual world as their world of evaluation. $C_7$ has received its default assignment from (21), the proposition that the speaker S holds the desideratum $\phi$ possible.

(29) $[\Box_\@ [\text{CF}_\@ [\lambda w' \Diamond_{\text{DOX},S,w'}(\phi) ]] [q \lambda w \text{I wish}_w \phi ]]$ 

LF for (15), final version

Given the semantics of wünschen, an isolated interpretation of the consequent (q) yields the following. q comes with the doxastic PSP (put between the colon and the period) that $\phi$ is held possible by the speaker S. On the truthconditional level (following the period), it denotes the proposition that S prefers $\phi$ to hold rather than not to hold.

(30) $[q] = \lambda w' : \Diamond_{\text{DOX},S,w'}(\phi). \text{ S prefers } \phi \text{ over } \neg \phi \text{ in } w$

Given that the antecedent is interpreted as q’s PSP, this PSP is accommodated and doesn’t project beyond the clause as a whole (31a). But (29) does not only not presuppose the PSP of q, it even presupposes that PSP’s negation (31b). This is what follows from the negative PSP ascribed to the CF-operator.

(31) $[ (29) ]$ is defined iff

a. $\Diamond_{\text{DOX},S,\@}(\phi)$ accommodation

b. $[\lambda w' \Diamond_{\text{DOX},S,w'}(\phi)](\@) = 0$

$= \neg \Diamond_{\text{DOX},S,\@}(\phi) \text{ S’s disbelief in } \phi$

$\square_w(p)$ quantifies over worlds that deviate from $w$ in nothing else than the truth of $p$ in them. Daniel Margulis was the first to bring the need for maximal similarity to my attention.

Thanks to Vera Hohaus for suggesting this simplification. Of course, things are way more subtle than (28) suggests them to be, also in light of the well-known fact that CF-inferences can be defeasible. Furthermore, they may be doxastic (or epistemic) in nature. In other words, CF(p) can be taken to presuppose something like an attitude holder’s disbelief in $p$. This is an analysis chosen by Grosz (2012).

This is only possible because the single CF-operator taking this PSP as its argument is truthconditionally vacuous. Accommodation precedes the anti-presuppositional inference I ascribed to wünschen in section 2, namely speaker-uncertainty about $\phi$. If uncertainty defined the interpretation of the antecedent, we would run into trouble accounting for the disbelief-implication, as I in fact did in Wimmer (2019).
Being truthconditionally vacuous, the CF-operator does not change the truth conditions of the antecedent, and leaves the ones of the conditional as a whole intact as well: In all closest worlds in which the speaker S holds $\phi$ possible, she prefers $\phi$ to hold rather than not to hold.

(32) If defined, \( [ (29) ] \) is true iff
for all closest worlds \( w^* \) among those in which \( \diamond \text{DOX}_S(\phi) \), S prefers $\phi$ over $\neg\phi$
'all closest worlds \( w^* \) among those in which S holds $\phi$ possible are such that S prefers $\phi$ to be true rather than to be false'.

These truth conditions say nothing about whether S has an actual preference for $\phi$. But the sentence they are ascribed to clearly implies such a preference to exist. In other words, it seems too weak that CF-marking on wünschen does not deny the desire. vF&I (2017) find an intuitive explanation: What seems to be implied is that "the only missing factor” keeping S from wishing that $\phi$ is $\phi$’s impossibility (vF&I 2017, slide 62). So while S has no desire for $\phi$ that qualifies as wishing, she is certain to have a different kind of desire: one that, unlike wishing, is an unrealistic one.

The conditionalized preference for $\phi$ in (32) doesn’t have to be wishing for $\phi$. It can also be gladness that $\phi$ is the case. Our sunshine-sentence from (15) can have a reading where S wishes to be taking a sunbath. In (33), gerade ‘right now’ adverbially supports this reading by creating a strict overlap of the desired state of affairs with the speech time. In the situation S is longing to be in, she is certain that the sun is shining, and she is hence glad that it is.

(33) Ich wünschte, $[\phi$ die Sonne schieße gerade $]$!
I wish-CF $[\phi$ the sun shine-CF right-now $]$

A similar point can be made if $\phi$ is shifted into the past as in (34). This shift is ensured by the use of the perfect, with CF-inflection on the perfect auxiliary haben ‘have’. On a plausible reading for (34), S longs to be in a situation in which she correctly remembers the sun to have shone the day before, and she would again be glad to find herself in such a situation.

(34) Ich wünschte, $[\phi$ die Sonne hätte geschienen $]$!
I wish-CF $[\phi$ the sun have-CF shone $]$

How come that we tend to read something as gladness that figures as wishing in (33) and (34)? This becomes less surprising in light of the contrastive analysis pursued for wünschen and freuen ‘be glad’ in section 2. On this analysis, building on Heim’s (1992) treatment of glad, freuen entails wünschen since it presupposes certainty about the desideratum, whereas

---

24 The phrasing follows Ogihara (2014).
25 As far as I can see, the truthconditional indifference as to S’s desire in (32) would be lost if the sentence they are ascribed to were subject to matrix exhaustification. If this were so, S’s preference for $\phi$ would be limited to antecedent-worlds. CF takes the antecedent and, by the semantics in (28), presupposes the actual world $\emptyset$ not to be an antecedent-world. So S’s desire would be indirectly implied not to obtain in $\emptyset$, which is exactly what an analysis of CF-wishes should not predict. This means that an LF like the following, with an exhaustivity operator such as Fox (2007)’s EXH stacked on top, is ruled out for reasons I leave to future investigation.

(i) \( (#\text{EXH}) [ [ \Box [ \text{CF} \diamond \text{DOX}_S(\phi) ] ] \text{I wish } \phi ] \)
\( \approx [\text{S holds } \phi \text{ impossible, and} ] \text{ all (#and only) worlds in which S holds } \phi \text{ possible are such that S prefers } \phi \text{ to be true rather than false} \)
wünsschen more weakly presupposes the desideratum to be possible. So if we run into CF-marked wünschen, this arguably reads as ‘I would at least wish for, if not even be glad that, φ’. If this sounds somewhat unintuitive, we can blame it on the anti-presuppositional inference I argued the use of wünschen to give rise to, taking freuen to be its stronger competitor: if the inference is drawn, holding φ possible is strengthened to holding both φ and ¬φ possible, a reading labeled as uncertainty regarding φ. This uncertainty-inference simply doesn’t seem to be drawn under CF-marking, see also footnote 22.

### 3.2. Option 2 > option 1

Up to this point, German CF-wishes, taken to be implicit CF-conditionals, were treated along the lines of option 2 in (35b). We could have chosen option 1 (35a), taking CF-marking on wünschen literally. This is the line of approach I pursued in Wimmer (2019).

(35) a. [ if [ CF p ] ] CF′ q option 1
b. [ if [ CF p ] ] Ø q option 2

Why exactly is option 2 preferable to option 1? This becomes clearer if we treat our initial example repeated in (36) along the lines of option 1.

(36) Ich wünschte, die Sonne scheine.
I wish-CF the sun shine-CF

The sketchy LF in (37) radicalizes option 1 and treats CF-marking on the complement φ as semantically contentful as well, just as we took it to be vacuous in our previous pursuit of option 2. Option 1 is neutral w.r.t. this option, but somewhat suggests it. Option 1 has a CF-operator above the silent antecedent, so it derives the disbelief-implication as well, (37a). This is desirable. However, it is less clear that we need the remaining PSPs triggered by the two additional CF-operators, CF′ and CF″. The second operator CF′ sits right above the consequent containing wünschen. On our simple analysis for the CF-operator, this means: S is presupposed to have no actual desire for φ. This is what we want to avoid: The puzzling persistence of the desire remains unexplained, making CF′ problematic.

(37) [ □ [ CF ◊DOX,S,φ ] ] [ CF′ I wish [ CF″ φ ] ]
presupposed:
   a. ¬◊DOX,S,φ (still) disbelief, via CF
   b. S does not prefer φ over ¬φ #absent speaker-desire, via CF′
   c. ¬φ φ is false, via CF″

The presence of CF″ is objectionable on different grounds. It doesn’t do any harm for sure. It presupposes φ to be false, (37c), which is in line with the disbelief-implication contributed by the first CF in (37a). But it also doesn’t seem to add anything new to it, so its presence might be ruled out based on considerations of structural economy. In the previous subsection, CF-marking on φ was treated as semantically vacuous as well. This view is supported by the ungrammatical absence of CF-marking on φ when the embedding wünschen is CF-marked:

---

In English, such vacuous CF-morphology is even attested in clauses embedded inside the complement of wish:

(i) a. I just wish [ I knew [ what went on inside that little head of his ] ]. Mindhunter, season 1, episode 6
b. I wish [ you were playing [ when I was visiting ] ]. Lilian Gonzalez, p.c.

(38) Ich wünsch-te, [φ die Sonne *scheint ].
I wish-CF [φ the sun *shine-IND ]

Summing up, there is reason to treat both instances of CF-marking in (36) as semantically vacuous. This speaks in disfavor of option 1 (35a), which takes CF-marking on a conditional consequent literally, and in favor of option 2 (35b), which treats it as vacuous. It should be noted though that option 2 does not entail the vacuity of CF-marking on φ. The analysis pursued in the previous subsection was to push option 2 one step further.  

4. Outlook

In this paper, I treated counterfactual (CF) marking on German wünschen as semantically vacuous. On the analysis proposed, all it does is to reflect CF-displacement of a silent antecedent denoting the doxastic possibility of what is being wished for (vF&I 2017). In analyzing CF-wishes as implicit CF-conditional, I followed the semantic pattern below. On this pattern, the antecedent p is counterfactually displaced, but the consequent q, despite the CF-morphology it carries, is not.

(39) [ if [ CF p ] ] q

Desiderata to be addressed by future research are manyfold. One puzzle pertains to the different behavior of German hoffen ‘hope’ and wünschen under CF-marking. While it is natural to form a CF-wish by CF-marking wünschen, one cannot form a CF-wish by CF-marking hoffen.  

(40) Ich {wünsch-te / hoff-te}, mein Kirschbaum blüh-te!
I {wish-CF / hope-CF} my cherrytree bloom-CF

What subtle differences between wünschen and hoffen might account for this difference? In terms of the implications of interest in the present paper, wünschen and hoffen pattern pretty much alike: The attitude holder is implied to be uncertain about what she has a desire for.

(41) Ich {wünsche mir / hoffe}, dass mein Kirschbaum blüht.
I {wish-IND myself / hope-IND} that my cherrytree bloom
‘I hope for my cherry tree to bloom.’
→ preference for & uncertainty about cherryblooming

Another perspective pertains to the different forms CF-wishes can take. The conditional pattern in (39) of course does not apply to CF-wishes across the board. There is variation at least w.r.t.

27 See Wimmer (2019) for a nonvacuous treatment of CF-marking on φ. I returned to this view in a chapter of my dissertation that otherwise contains the analysis pursued in the present paper.
28 This was brought to my attention, in some way or other, by Valentine Hacquard at CLS 54, and by Thomas Ede Zimmermann at SuB 24.
the structural location of the desideratum $\phi$. To clarify this, I specify (39) for CF-wishes. Round brackets surround parts of the LF that are not spelled out.

(42)  
\[
\text{(if } [\text{CF} [p \diamond \phi ] ] \text{)} [q \text{ preference for } \phi ]
\]

pattern for German CF-wishes

On (42), $\phi$ figures in both the consequent $q$ and the silent antecedent $p$. The latter denotes $\diamond \phi$, $\phi$’s (doxastic) possibility. In deviation from (42), Japanese and Chinese share a type of CF-wishes that has $\phi$ as its overt antecedent. This is exemplified by the Japanese example in (43a)\(^{29}\) and the Chinese one in (43b). $\phi$ is the proposition that the rain ends. The consequent is reduced to an evaluative predicate such as *good*. The Japanese variant crucially has the regret-particle *noni* attached to the consequent (Ogihara 2014).

(43) a.  
\[
[\text{Ame-ga yan-dara ii-noni.}]
\]
\[
[\text{rain-NOM stop-if } ] \text{ good-noni}
\]

b.  
\[
[\text{Yu ting xia jiu hao le!}]
\]
\[
[\text{rain stop fall jiu good ASP}
\]

$\sim$ preference for the rain to end, but no end in sight

In partial conformity with the pattern in (42), the consequent clauses in (43) can be taken to express a preference for $\phi$ if we follow Sode (2018) in thinking of *good* as an evaluative *predicate of worlds*. The implied preference for $\phi$ would then be derived from a preference for worlds in which $\phi$ holds over those in which it does not. In clear deviance from (42), however, the antecedent is spelled out, even though it lacks overt CF-marking. The resulting pattern is this:\(^{30}\)

(44)  
\[
[\text{if } (\text{CF} \phi ) ] [q \text{ preference (for } \phi ) ]
\]

pattern for (43)

These crosslinguistic similarities and differences present a strong incentive for future research.

References


\(^{29}\)I owe this example to Toshiko Oda.

\(^{30}\)As it turns out, there is no need to stray far from English or German to find a similar pattern for CF-wishes as exhibited by (43). On the surface, optative CF-wishes (Grosz (2012)) are bare CF-antecedents denoting the desideratum:

(i) a.  
\[
\text{Wenn es nur aufhören würde zu regnen!}
\]
\[
\text{if only stop would to rain}
\]

b.  
\[
\text{If only the rain would stop!}
\]

$\sim$ preference for the rain to end, but no end in sight

Still, these sentences deviate from their Sino-Japanese counterparts in (43) in the following respects: First, their antecedents contain *only* as an optative marker. Second, they CF-mark their antecedent *overtly*. Third, they leave their consequent implicit, while their counterparts spell it out.


Challenging the presuppositions of questions: the case of \textit{ba}-interrogatives
Xuetong YUAN — University of Connecticut

Abstract. This paper investigates the use of the Mandarin discourse particle \textit{ba} in polar questions and \textit{wh}-questions. With the introduction of a set of new scenarios where \textit{ba}-interrogatives are (in-)felicitous, the paper shows that (i) \textit{ba}-attached questions are typically used to challenge the presupposition of a contextually salient Question Under Discussion (henceforth QUD), and (ii) \textit{ba} is particularly sensitive to the commitments from the addressee. These findings support the presence of a hierarchical discourse structure (Büring, 2003; Roberts, 1996), and the various components in the context.

Keywords: Discourse particles, QUD, Table stack, presupposition, Mandarin.

1. Introduction

Mandarin \textit{ba} is one of the 28 discourse particles in the language (Chao, 1968). It typically occurs utterance-finally, and cannot be embedded. \textit{ba} has been observed to occur both in declaratives, and in morphosyntactically-marked interrogatives\footnote{In Mandarin, declaratives are usually not morphosyntactically-marked. Interrogatives can be marked in many ways: by sentence-final particle \textit{ma}, by \textit{wh}-words, by question intonation, etc. In this paper, I only discuss the relevant data of questions without \textit{ma}, since \textit{ma} and \textit{ba} cannot co-occur.}. When \textit{ba} attaches to declaratives, it adds the flavor of suggestion or uncertainty to the host, as shown in (1) and (2).

\begin{enumerate}
\item \begin{enumerate}
\item \textit{ni} \hspace{1em} \textit{chi} \\
you \hspace{1em} eat
\end{enumerate}
\item '(Eat!'
\item \begin{enumerate}
\item \textit{ni} \hspace{1em} \textit{chi ba}
\item you \hspace{1em} eat BA
\end{enumerate}
\item '(How about you) eat.'
\end{enumerate}
\begin{enumerate}
\item \begin{enumerate}
\item \textit{ting} \hspace{1em} \textit{hao} \hspace{1em} \textit{de}
\item very good DE
\end{enumerate}
\item 'Very good.'
\item \begin{enumerate}
\item \textit{ting} \hspace{1em} \textit{hao} \hspace{1em} \textit{de} \hspace{1em} \textit{ba}
\item very good DE BA
\end{enumerate}
\item '(Maybe) very good.'
\end{enumerate}

In the contrast shown in (1), \textit{ba} turns a command to a suggestion. In (2), \textit{ba} receives a modal-like interpretation. This ‘uncertainty’ meaning of \textit{ba} can also be found in cases like (3b), where the \textit{ba}-declarative can be translated as a confirmation-seeking question. For (3b), the speaker is unsure about the issue she expresses in a way that she needs the addressee to confirm. For (2b), no addressee’s reply is required.

\begin{enumerate}
\item \begin{enumerate}
\item \textit{Yuehan mingtian} \hspace{1em} \textit{hui} \hspace{1em} \textit{qu xuexiao}
\item John \hspace{1em} tomorrow \hspace{1em} will \hspace{1em} go \hspace{1em} school
\item 'John will go to school tomorrow.'
\end{enumerate}
\item \begin{enumerate}
\item \textit{Yuehan mingtian} \hspace{1em} \textit{hui} \hspace{1em} \textit{qu xuexiao} \hspace{1em} \textit{ba}
\item John \hspace{1em} tomorrow \hspace{1em} will \hspace{1em} go \hspace{1em} school \hspace{1em} BA
\item 'John will go to school tomorrow, right?'
\end{enumerate}
\end{enumerate}

\footnote{I am grateful to Magdalena Kaufmann for discussions and comments on this project. Thanks also to Adrian Brasoveanu, Donka Farkas, Kangzheng Gao, Stefan Kaufmann, Si Kai Lee, Michael Wagner, Shuyan Wang, Muyi Yang, the audience at GLOW in Asia XII, SuB 24, and UConn Meaning Group for their judgments and useful comments. All remaining errors are mine.}

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ba-interrogatives, on the other hand, typically appear in “impatience” scenarios (Ettinger and Malamud, 2015), expressing the speaker’s impatience or anger. In (4) and (5), ba gives an additional “unfriendly” effect to the questions: the speaker is impatient about their current conversation status.

(4) ni daodi yao shenme ba?
you on-earth want what BA
‘(Tell me), what on earth do you want?’ (Chao 1968: 807)

(5) Daodi shei qu ba?
on-earth who go BA
‘Who is going anyway (I am losing my patience now!)?’ (Han 1995: 101)

ba’s meaning in declaratives has been widely discussed in the previous literature. For instance, Li and Thompson (1989) have described the function of ba as ‘soliciting-agreement’. Han (1995) proposes that ba weakens the “neustic” in declaratives and imperatives. Chu (2009) generalizes the uses of ba as ‘uncertainty’. More recently, Ettinger and Malamud (2015) try to provide a unified account of the meaning of ba. They argue that ba serves to weaken the force of the assertion or the directive it attaches to, and correctly point out that ba-interrogatives are only felicitous in very restricted discourse contexts (i.e. the “impatience” scenarios). While capturing some crucial intuitions about the meaning of ba, Ettinger and Malamud (2015) fail to integrate the so-called “impatience” condition into an overall account of the semantics and pragmatics of ba-interrogatives. I will show in paper that the stipulation of adding “impatience” seems coarse-grained.

The paper has two goals. First, concentrating on the data of ba-interrogatives as in (4) and (5), I show that ba-interrogatives traverse the discourse trees upward (a.o., Büring, 2003; Rojas-Esponda, 2014): ba can either attach to the contextually salient QUD, or to a question challenging the presupposition of the QUD. I propose that ba adds two contextual preconditions, from which the “unfriendly” effect carried by ba-interrogatives is derived. Second, departing from Mandarin, I further compare ba with a set of discourse particles which share the use of challenging presuppositions (e.g. German überhaupt in Rojas-Esponda, 2014; English even in Iatridou and Tatevosov, 2016), but differ in additional restrictions on the contexts in which they can be used felicitously. I show that the contextual restrictions which license ba can be used to explain the (in-)felicity of other presupposition-challenging particles in similar scenarios, which will provide insights into subtle differences in the meaning and use of pragmatically similar discourse particles.

The paper is structured as follows: §2 presents the typical “impatience” scenarios where ba-interrogatives are felicitous, as well as the “out-of-the-blue” scenarios where ba-questions cannot be felicitously used. §3 proposes two preconditions on ba regarding how ba is used to signal the intended discourse tree. §4 compares ba with three other discourse particles: Mandarin a, German überhaupt, and English even. I use the proposed preconditions to “parameterize” the different uses among these presupposition-challenging particles (e.g. particles from different languages may be sensitive to different contextual components). §5 concludes.

3 Imperatives are not necessarily marked in Mandarin. When strings like (1) and (2) are used for directive speech acts, Ettinger and Malamud (2015) call them imperatives.
2. Scenarios for \textit{ba}-interrogatives

This section aims to narrow down the contexts where \textit{ba}-interrogatives are felicitous. It has been noticed for a long time that whether \textit{ba} is felicitous in a question depends on the previous discourse. In truly out-of-the-blue scenarios, certain \textit{ba}-questions such as (6) are infelicitous. But if we modify the scenario by adding a suitable previous discourse moves, as in (7), the same \textit{ba}-question becomes felicitous.

(6) [A approaches a stranger in a classroom.]

\begin{verbatim}
A: buhaoyisi, zhe ti zenme zuo (#ba)?
   excuse-me this problem how do BA
\end{verbatim}

A: ‘Excuse me, (do you know) how to solve this problem (#ba)?’

(7) [A and B have been discussing how to solve a mathematical problem for a long time. B rejected every solution that A provided, A to B:]

\begin{verbatim}
A: zhe ti zenme zuo ba?
   this problem how do BA
\end{verbatim}

‘(Come on), how to do this problem?’

In a scenario like in (7), which is dubbed as “impatience” scenarios by Ettinger and Malamud (2015), \textit{ba}-questions typically show “unfriendly” effect: after making several unsuccessful attempts of resolving a mathematical problem, the speaker becomes impatient and thus asks a \textit{ba}-question to request a solution.

Previous literature have noticed the necessity of the speaker’s impatience for \textit{ba}-interrogatives to appear (a.o., Chao, 1968; Han, 1995; Ettinger and Malamud, 2015). However, as mentioned in §1, the impatience condition is somewhat ad hoc, if we re-exemplify the scenario in (7) as follows:

(8) [A is trying to solve a mathematical problem of which B knows the solution.]

\begin{itemize}
  \item[i.] A: Does the Lagrange theorem help?
  \item[ii.] B: No.
  \item[iii.] A: Hmm...will the Fourier expansion do the trick?
  \item[iv.] B: No.
  \item[v.] A: # lianshifaze shi bu shi daan ba?
       chain-rule is NEG is answer BA
\end{itemize}

A: ‘Is chain rule the answer?’

(8) is a possible expanded conversation of the scenario in (7). At the point where A is asking the question (8v), we can infer from the previous conversation that A should have already been impatient on offering possible solutions. Although the impatience condition is satisfied in the scenario in (8), as we can see, the \textit{ba} question (8v) is still infelicitous. This suggests that rather than the speaker’s impatience, \textit{ba} is particularly sensitive to the form and the content of the
questions it attaches to. The infelicity of (8v) thus raises the question of what exactly are the pragmatic conditions that license ba-interrogatives, which we will further discuss in the rest of the section.4

2.1. (In-)felicitous uses of ba-interrogatives

Let us first consider the CAKE CASE in example (9). The scenario in (9) exemplifies a context where two kinds of ba-interrogatives are felicitous (9vi and 9vii). First, notice that in (9) the picky child B makes a public commitment at the beginning of the conversation; that is, there is some cake that B will eat, by uttering (9i). Inducing by the commitment (9i), in the following conversation the mother A attempts to figure out the general question of what cake B will eat by asking two more specific questions (9ii) and (9iv). After receiving two negative answers from B, A is losing her patience and uses a ba-question strategy to terminate the conversation: A can either ask the general question (i.e. the QUD) with ba explicitly (9vi), or a question challenging the presupposition of the general question with ba as in (9vii). Note that the underlined part in (9vi) and (9vii) signals that they are syntactically-marked interrogatives: shenme is a wh-word, meaning ‘what’; and chi-bu-chi is an A-not-A construction, marking one type of polar questions in Mandarin.

(9) THE CAKE CASE:  
[A = Mother, B = picky child. The mother only prepares two kinds of cake for dinner: strawberry and chocolate.]

i. B: wo xiang chi dangao. B: I want to eat cake.

ii. A: hao, ni chi bu chi caomei dangao? A: Okay, will you eat strawberry cake?


vi. A: ni chi shenme dangao ba? A: What cake will you eat ba?

vii. A’: ni chi [ ] bu chi dangao ba? A’: Will you eat cake ba?

Similar to the contrast between example (7) and (8), the ba-question (10i) cannot be felicitously used in the scenario in (9). That is, ba cannot attach to a question which is in the same form as the specific questions being asked in the previous conversation. The question (10ii), which is the presupposition-challenging question without ba attaching, is also infelicitous in the CAKE CASE. The reason of the infelicity of (10ii) is evident: with B’s commitment (10i), asking (10ii) would simply be redundant.

(10) THE CAKE CASE (continued): A = Mother, B = Picky child  

i. A”: # ni [ ] chi bu chi nailao dangao ba? A”: Will you eat cheese cake ba?

ii. A”’: # ni [ ] chi bu chi dangao? A”’: Will you eat cake?
B’s commitment in the CAKE CASE is necessary for ba-questions to be felicitous. In a modified scenario in (11), where the addressee B’s commitment is absent, asking a ba-question to challenge the presupposition of the QUD becomes infelicitous since here ‘B eats cake’ is simply the speaker A’s implicit assumption.

(11) THE CAKE CASE (no commitment):
[B is having dinner in A’s house. A plans to serve some cake as dessert now.]

i. A: ni chi bu chi caomei dangao? A: Will you eat strawberry cake?
ii. B: bu.
iii. A: ni chi bu chi qiaokeli dangao? A: Will you eat chocolate cake?
iv. B: bu.
v. A: # ni chi shenme dangao ba? A: What cake will you eat ba?
vi. A’: # ni chi bu chi dangao ba? A’: Will you eat cake ba?

Before we make the conditions for ba-questions more precise in the next section, let us consider one more scenario to familiarize ourselves with the felicitous contexts of ba-questions:

(12) THE TRAVEL CASE:
[B plans to visit A, and they live in different cities. Valid transportation between the two cities involves plane, train, and bus, assuming that there is no notable downsides for each of the three methods.]

i. B: wo xiazhouliu qu. B: I will go (to your place) next Saturday.
ii. A: ni zuo bu zuo feiji lai? A: Are you coming by air?
iii. B: bu.
iv. A: ni zuo bu zuo huoche lai? A: Are you coming by train?
v. B: bu.
vi. A: ni zuo bu zuo qiche lai? A: Are you coming by bus?
viii. A: ni zenme lai ba? A: How do you (plan to) come ba?
ix. A’: ni lai bu lai ba? A’: Are you coming ba?

The TRAVEL CASE in (12) provides us with another typical scenario where ba-interrogatives can appear. All the contextual factors that ba is sensitive to are satisfied in the given scenario: the addressee B’s commitment to the presupposition of the QUD (are you coming?), and several unsuccessful attempts of resolving the QUD in the previous conversation. What is worth noting for this scenario is that the interlocutors have exhaustified all the possible means of traveling between the two cities before asking a ba-question. An exhaustification of all the possible alternatives can also be found in the CAKE CASE: all kinds of cake the mother has on hand are strawberry and chocolate. This factor plays a crucial role in both scenarios: only when the speaker cannot think of any other possible alternatives can a ba-question be felicitously asked. The intuition behind this exhaustification condition is that asking a ba-question to challenge the validity of the QUD would be improper unless the previous discourse signals that the QUD is not answerable.
For an example that illustrates this point, consider (13). In this scenario, A obviously knows that not all students are excluded by B’s negative replies, so the possible alternatives of the QUD are not exhaustified. Here, the infelicity of the question is due to the presence of \textit{ba}. If \textit{ba} is omitted, A’s question becomes acceptable very naturally.

\begin{enumerate}
  \item \text担保 list case (no exhaustification):
  \begin{enumerate}
    \item A and B are organizing a class-internal party. There are six students including A and B in the class in total.
    \item B: mingdan queding le. B: The name list has been determined.
    \item A: Su qu bu qu? A: Is Sue going?
    \item B: bu. B: No.
    \item A: Bier qu bu qu? A: Is Bill going?
    \item B: bu. B: No.
    \item A: # shei qu ba? A: Who goes \textit{ba}?
  \end{enumerate}
\end{enumerate}

The scenario in (13) again demonstrates that a more restrictive set of conditions for \textit{ba}-questions is needed: even if in (13) \textit{ba} attaches to the right ‘type’ of question (i.e. the QUD), and the context satisfies the commitment condition, the \textit{ba}-question (13vi) is still not felicitous. In other words, an account for \textit{ba}-questions should be able to explain \textit{ba}’s sensitiveness of the content of the questions, as well as how the commitment and the exhaustification condition are formulated. To foreshadow a bit, in the next section we will formalize the two conditions discussed here as \textit{ba}’s two \textit{preconditions} within the Table model proposed by Farkas and Bruce (2010). We will show that the discourse leading to \textit{ba}-questions requires a conflict to exist in the context: the addressee has been committed to the presupposition that the QUD is answerable, whereas the unsuccessful attempts of resolving the QUD in the previous conversation signal that the QUD might not be answerable. The implied impatience or anger of a \textit{ba}-interrogative is thus generated from this conflict.

2.2. Summary of the data

So far from the empirical data we have observed that (i) \textit{ba} selects a particular type of questions, and (ii) a \textit{ba}-marked question specifies two necessary preconditions for the previous context. Preliminary generalizations are made in (14) and (15).

\begin{enumerate}
  \item \textbf{Questions} that \textit{ba} can attach to:
    \begin{enumerate}
      \item the current Question Under Discussion;
      \item questions challenging the presupposition of the QUD.
    \end{enumerate}
  \item \textbf{Descriptive generalizations:}
    A \textit{ba}-interrogative can be used felicitously only if:
    \begin{enumerate}
      \item the addressee is committed to the presupposition of the QUD;
      \item the previous conversation signals that the QUD has no true answer (i.e., that the residual answer is true; Hamblin, 1973).
    \end{enumerate}
\end{enumerate}
3. Proposal

In this section I will give an account of the behavior of ba in questions which contains two parts. First, I argue that ba-interrogatives traverse the discourse trees upward. Second, I propose two preconditions on the input context of ba-interrogatives, formalized within Farkas and Bruce (2010)’s Table model, which allows for an account of the asymmetry of the commitments of discourse participants. §3.1 discusses how ba-interrogatives inform the hierarchical discourse structure. §3.2 introduces theoretical preliminaries. §3.3 lay out the core proposal, the two preconditions, and sample updates on the input contexts of ba-questions. §3.4 discusses further predictions made by this proposal.

3.1. Mapping ba-interrogatives to discourse trees

I adopt the d-tree model (a.o. Roberts, 1996; Büring, 2003; Rojas-Esponda, 2014) in which conversations are modeled as a hierarchical structures of discourse moves. Each node in a d-tree represents a declarative or an interrogative sentence. These nodes can be understood either as questions set up for interlocutors to resolve or answers to these questions.

I argue that ba-interrogatives traverse the discourse trees upward as follows. To resolve a complex question (the QUD), interlocutors in a conversation may proceed from the complex question to several subquestions, i.e. simpler questions providing complete or partial answers to the complex question. The QUDs and their subquestions together form a discourse hierarchy, a d-tree, which contains a sequence of nodes of questions. (16) presents a possible d-tree of the conversation in (9).

(16)

```
What dessert will you eat?

What pie will you eat?  What cake will you eat?  ...

Strawberry?  Chocolate?  Banana?  Cheese?  ...
```

Take the CAKE CASE scenario in (9) as an example. The QUD of the conversation is what cake will you eat, which is brought up by B’s request (9i) I want to eat cake. By uttering (9i), the addressee makes sure that there should be at least some cake that she eats, which satisfies the commitment condition. Assuming this, the speaker uses several simpler subquestions (Will you eat strawberry cake? Will you eat chocolate cake?) as strategies to resolve the higher QUD. This is a natural flow within a d-tree, which goes from a higher node to lower nodes. However, as the conversation goes, the subquestions that the speaker asks seem to give the QUD the “residual” answer (Hamblin, 1973); in other words, the conversation signals that there is no true answer to the QUD. In this situation, it is reasonable for the speaker to perform two kinds of moves using ba: (i) the speaker assumes there should be no presupposition failure given the addressee’s commitment, and asks for the answer to the QUD by explicitly uttering the QUD; (ii) doubting whether the QUD is valid by challenging the presupposition of the QUD.

(17)  B: I want to eat cake.  (QUd: what cake will you eat?)
A: Okay, will you eat strawberry cake?  
B: No.  
A: Will you eat chocolate cake?  
B: No.  
A: What cake will you eat ba?  
A': Will you eat cake ba?  

The standard traversal rule of a d-tree corresponds to the linear order of the nodes, i.e. interlocutors may move from a node to its sister or daughter. I argue that a ba-interrogative marks a move from a node to its predecessors. The form of a ba questions explicitly reflects either the higher-level question itself or the presupposition of the parent node.

3.2. Theoretical background

In the literature discourse contexts have been introduced as a tuple consisting of different discourse components (a.o. Gunlogson, 2004; Farkas and Bruce, 2010; Rawlins, 2010; Farkas and Roelofsen, 2017). In this paper I adopt Farkas and Bruce (2010)’s model because the components in this model allow us to trace the source of the public commitments that each interlocutor make, as well as the potential of resolving the current issue predicted by updating the contexts.

Farkas & Bruce’s model elaborates the Stalnakerian update of assertions in a way that it models an intermediate step in the update process: before updating the Common Ground, the content of an utterance is first put onto the Table; the addressee can either choose to accept or reject the proposals on the Table. The Common Ground is updated by the content only when the content is accepted by all interlocutors. The Table, a discourse component in Farkas and Bruce (2010)’s model, is defined as a stack of issues (sets of propositions). It keeps track of the proposals for updating the common ground. Apart from the Table, there are two other conversational components that play crucial roles in my account: the Discourse Commitments sets (DC_x) for each interlocutor x, and the Projected Set (PS). The DC_x are used in my account follow the definition of public beliefs proposed by Gunlogson (2004). According to Gunlogson’s definition, a public belief of an individual is not necessarily a mutual belief, but propositions in DC_x are also part of the Common Ground.

(18) Let CG{A, B} be the Common Ground of a discourse in which A and B are the individual discourse participants.

a. DC_A of CG{A, B} = \{p: ‘A believes p’ ∈ CG{A, B}\}  
b. DC_B of CG{A, B} = \{p: ‘B believes p’ ∈ CG{A, B}\}  

(Gunlogson 2004: 41)

In order to show the different effects an assertion or a question makes to the contexts, Farkas and Bruce (2010) propose that moves placed on the Table simultaneously project a set of future common grounds, the Projected Set (PS). In other words, PS suggests possible ways of resolving the current issue. When an assertion is put on the Table, the PS will be updated by the proposition p. When a question is proposed, the PS will be updated by all the possible answers to the question Q, assuming that interrogatives denote sets of possible answers (Hamblin, 1973). The updating operation PS ∪ P is defined in (19), which says that an updated PS is a new collection of possible developments of the common ground, and each future cg is created by
adding one proposition in $P$ to the previous $cg$. The future $cgs$ in the new collection $PS$ should be consistent; inconsistent future $cgs$ will be eliminated.

(19) Definition of $PS$:

a. Let $PS = \{cg_1, \ldots, cg_n\}$ be a collection of sets of propositions (e.g. possible common grounds) and let $P = \{p_1, \ldots, p_m\}$ be a set of propositions.

b. $PS \cup P = \{cg_i \cup \{p_j\} | cg_i \in PS$ and $p_j \in P$ and $(cg_i \cup \{p_j\}) \neq \emptyset\}$

(i.e. only keeps the consistent future common grounds)

(Modified from Farkas and Bruce 2010)

In this spirit, I assume that a context $c$ is a tuple $\langle A, T, DC_x, CG, PS \rangle$, shown in (20).

(20) Context $c = \langle A, T, DC_x, CG, PS \rangle$, where

a. $A$ a set of discourse participants ($s$ for speaker, $a$ for addressee);

b. Common Ground ($CG$): the set of propositions that all discourse participants are publicly committed to;

c. Discourse Commitments ($DC_x$): the set of propositions that each discourse participant is publicly committed to;

d. The Table ($T$): a stack of sets of propositions (issues);

e. Projected Set ($PS$): the set of supersets of the current CG that projects future common grounds relative to which the issue on the Table is decided.

Under this framework, the question operator $\text{QUEST}$ is defined as shown below. It maps interrogative meanings $Q$ and input contexts $K_i$ to output contexts $K_o$. Only updated discourse components are listed below; unmentioned aspects remain the same as their inputs. The subscripts $i$ and $o$ stand for input and output respectively.

(21) $\text{QUEST} (Q, K_i) = K_o$:

a. $T_o = \text{PUSH} (Q, T_i)$

b. $PS_o = PS_i \cup Q$  \hspace{1cm} (Modified from Farkas & Bruce 2010)

(21) says that when a question $Q$ is asked, the denotation of the question$^5$ is pushed onto the top of the stack. Each proposition in the question $Q$ can potentially update the CG. Thus the PS is updated with all the possible answers to $Q$. Usual stack operations are assumed, $\text{PUSH} (e, T)$ in (21a) represents the new stack obtained by adding the issue $e$ onto the stack $T$ (see also Farkas and Bruce, 2010).

3.3. The discourse dynamics of $ba$-interrogatives

With all the tools introduced in §3.2, we are now ready to formulate the preconditions for $ba$-interrogatives. We assume that adding $ba$ to an interrogative does not change the denotation of the question, (i.e. $[\phi?] = [\phi - ba?]$), but introduces preconditions on the input contexts. In (22) $cg$ represents a future common ground in the PS, and $Q^+$ represents the QUD.

$^5$In Farkas and Bruce (2010)'s original proposal, items pushed onto the Table are pairs of denotations and syntactic structures of sentences. In (21) I omit the syntactic part since it is unrelated to what is under discussion here.
Formally, \( ba \) adds the following two preconditions:

a. \( \lambda w. \exists p \in Q^+[p(w)] \in DC_{a,i} \)

b. \( PS_i \cup Q^+ = \emptyset \) (i.e. for all \( cg \in PS_i, \cap(cg \cup \{Q^+\}) = \emptyset \))

When (22a) and (22b) are satisfied, \( \phi - ba? \) is felicitous only if

\[ [\phi] = Q^+ \], or \([\phi] = \{\cup Q^+, \cup \overline{Q^+}\}\)

(22a) accounts for our first generalization (15a): the addressee must commit herself to the presupposition of the QUD before uttering \( ba \)-interrogatives. The formula in (14a) tells us that the proposition of there being a true answer to the \( Q^+ \) is in the addressee’s input commitment set. (22b) sets a condition on the input PS such that updating the PS with the QUD \( Q^+ \) returns an empty set. In other words, all the future common grounds in the input PS for a \( ba \)-question should be inconsistent. This is similar to saying that the issue on the Table is not resolvable. This accounts for our second observation that before uttering \( ba \)-interrogatives the previous discourse seems to entail that \( Q^+ \) is not answerable.

Let us see how (22) implements our informal generalizations of the meaning contributions made by \( ba \). Take conversation (9) again as an example. Before anything is uttered, we assume that the initial context state \( K_1 \) has the following structure:

\[
\begin{array}{c|c|c}
DC_s & \text{TABLE} & DC_a \\
\{\ldots\} & \{\} & \{\ldots\} \\
\hline
\text{COMMON GROUND } cg & \text{PROJECTED SET } PS = \{cg\}
\end{array}
\]

When (9i) \( I \text{ want to eat cake} \) is uttered, the addressee is committed to there being a true answer to the QUD \( \text{what cake will you eat} \). In other words, the addressee has committed herself to the proposition in the form of \( p_1 \lor p_2 \), assuming that only strawberry cake and chocolate cake count as possible answers to the QUD. When the speaker says \( okay \) in (9ii) and starts looking for an answer to the QUD, we assume that at this point both interlocutors agree that they are going to resolve this issue, and thus the QUD \( \text{what cake will you eat} \) is introduced and put onto the Table.

\[
\begin{array}{c|c|c}
DC_s & \text{TABLE} & DC_a \\
\{\ldots\} & \{\{p_1,p_2\}, \{\}\} & \{p_1 \lor p_2, \ldots\} \\
\hline
cg = \{p_1 \lor p_2, \ldots\} & PS = \{cg \cup \{p_1\}, cg \cup \{p_2\}\}
\end{array}
\]

where \( p_1 = a \) will eat strawberry cake, \( p_2 = a \) will eat chocolate cake.

Next, the speaker asks a subquestion of the QUD, \( \text{will you eat strawberry cake} \). The addressee, by answering with \( no \), has committed herself to the proposition \( \neg p_1 \). Hence the \( DC_a \), the CG,
and the PS are all updated with the proposition \( \neg p_1 \). We see that one of the future cg becomes inconsistent after updating with \( \neg p_1 \), and is thus discarded. The addressee’s answer completely resolves the subquestion, and thus the subquestion is popped off the stack. (25) shows the context state after updating with the addressee’s answer no in (9iii).

(25) \( K_3 \): The context state after -Will you eat strawberry cake? -No.

<table>
<thead>
<tr>
<th>( DC_s )</th>
<th>( TABLE )</th>
<th>( DC_a )</th>
</tr>
</thead>
<tbody>
<tr>
<td>{...}</td>
<td>{{p_1, p_2}, {}}</td>
<td>{p_1 \lor p_2, \neg p_1, \ldots}</td>
</tr>
<tr>
<td>( cg = { p_1 \lor p_2, \neg p_1, \ldots } )</td>
<td>( PS = { eg \cup {p_1} \cup {\neg p_1}, cg \cup {p_2} \cup {\neg p_1} } )</td>
<td></td>
</tr>
</tbody>
</table>

\( p_1 = a \) will eat strawberry cake

The update of the second subquestion will you eat chocolate cake and its response no repeats the process in (25). After updating with the addressee’s commitment \( \neg p_2 \), the remaining future cg in the PS is inconsistent and is thus eliminated, the PS becomes empty, which satisfies the precondition (22b), the input \( PS \cup Q^+ = \emptyset \). The PS turns out to be empty, but the issue (the QUD) is still on top of the Table, which gives us a conversational crisis. Notice also that the addressee’s commitment of there being a true answer to the QUD is in the \( DC_a \), which satisfies the preconditions (22a). When the input preconditions are all satisfied, both ba-questions what cake will you eat ba (QUD restated) and will you eat cake ba (presupposition of the QUD) are possible moves.

(26) \( K_4 \): The context state after -Will you eat chocolate cake? -No.

<table>
<thead>
<tr>
<th>( DC_s )</th>
<th>( TABLE )</th>
<th>( DC_a )</th>
</tr>
</thead>
<tbody>
<tr>
<td>{...}</td>
<td>{{p_1, p_2}, {}}</td>
<td>{p_1 \lor p_2, \neg p_1, \neg p_2, \ldots}</td>
</tr>
<tr>
<td>( cg = { p_1 \lor p_2, \neg p_1, \neg p_2, \ldots } )</td>
<td>( PS = { eg \cup {p_2} \cup {\neg p_1} \cup {\neg p_2} } )</td>
<td></td>
</tr>
</tbody>
</table>

\( p_2 = a \) will eat chocolate cake.

3.4. Further predictions

We find that if we form a scenario which satisfies both preconditions, but without a sequence of subquestions in a conversation, ba-questions can be acceptable as well.

(27) The namelist case

[Professor A and Professor B are organizing an open house event. There are three prospective students on the list: Sue, Bill, Mary.]

i. B: The namelist has been determined.

ii. A: Who is coming?

iii. B: Well, Bill is not coming, Mary is not coming, Sue is not coming...

iv. A: shei_lai ba?

what come BA
A: ‘Who is coming ba?’

This observation can be predicted by the current proposal. In (27), B is committed to there being some students coming to the event since there seems to be a namelist of the event. What is different from the cases we have seen in §2 is that here the QUD is explicitly asked by the speaker, and no subquestion is being asked in the scenario in (27). Instead, B answers the QUD by denying all the possible answers to the QUD. So, after updating B’s answer in (27iii), the PS becomes empty as well, which satisfies our exhaustification condition. Since both preconditions are satisfied, a ba-question is predicted to be acceptable, which is the result we find in (27). Another possible scenario for exhaustifying all the possible answers is shown in (28).

(28) [A is trying to push B to finish her homework. B is usually unreliable, and her words usually cannot be taken very seriously.]
   i. B: I will definitely finish it by the end of this week.
   ii. A: Really? When do you plan to do it?
   iii. B: Well, today, I guess...
   iv. A: bukeneng, bie kaiwanxiao. ni dasuan shenmeshihou xie ba?

A: ‘That’s impossible, stop joking. When do you plan to write it ba?’

In (28), B responds to the QUD by providing an answer which both of the interlocutors consider as impossible. That is to say, the answer that B provides is outside the domain of the QUD, and thus is in the form of \( \neg p_1 \land \neg p_2 \land \ldots \land \neg p_n \). Updating the PS with an impossible answer will always result in an empty set. In this way, the scenario in (28) also satisfies both preconditions, and we find that a ba-question can appear in this scenario.

4. Crosslinguistic extensions

As mentioned above, there are several related particles which can also be used to challenge presuppositions, but the contexts where they appear are slightly different from ba’s. In this section I show how the proposed preconditions can be used to “parameterize” the different uses among these presupposition-challenging particles.

4.1. Mandarin a

a is a Mandarin discourse particle that is often used to express the speaker’s surprise or disbelief (29). It has been noted in the literature (e.g. Han, 1995) that particle a can also attach interrogatives in Mandarin, as shown in (30). But unlike ba-interrogatives, a-questions do not have ‘unfriendly’ effects. Rather than indicating a conversational crisis (Farkas and Bruce, 2010), the speaker uses an a-question to take a step back and politely ask if her implicit assumption is valid, otherwise the previous conversation built on the speaker’s assumption would be pointless.

(29) a in declaratives:
[A gives B a pineapple as a present, but B tells A that she is allergic to pineapples. A to B:]
You cannot eat pineapples (you must be joking/that’s unexpected)!

(30) \textit{a} in interrogatives:
B: I heard that John is going to teach us math next semester.
A: buhaoyisi, dan Yuehan shi bu shi jiaoshou \textit{a}?
sorry but John is \textit{NEG} is professor \textit{A}
A: ‘I am sorry, but is John a professor?’

Interestingly, an \textit{a}-question can also be used in the \textit{CAKE CASE}, but the proceeding context is different: \textit{a}-questions are unacceptable if there is some addressee’s commitment in the previous discourse. A felicitous scenario for \textit{a}-questions is shown in (31), where \textit{a} is used to express the speaker’s surprise about the invalidity of her assumption of whether B eats cake (i.e. the presupposition of the QUD).

(31) \textbf{THE CAKE CASE}
B: I want to eat cake.
A: Will you eat strawberry cake?
B: No.
A: Will you eat chocolate cake?
B: No.
A: \textit{ni chi shenme dangao a}\textit{/ni chi bu chi dangao a}?
A: What cake will you eat a\textit{/Will you eat cake a}?

4.2. German \textit{überhaupt} and English \textit{even}

Rojas-Esponda (2014) observes similar ‘stepping back’ effects of German particle \textit{überhaupt}: \textit{überhaupt}-marked questions can also be used to doubt the presupposition of the QUD, shown in (32).

(32) i. A: Möchtest du ein Glas Wein? A: Would you like a glass of wine?
   B: Nein, Danke. B: No, thank you.
ii. A: Hättest du gerne ein Bier? A: Would a beer appeal to you?
   B: Nein.
iii. A: Trinkst du \textit{überhaupt} Alkohol? A: Do you drink \textit{überhaupt} alcohol?
   B: No.

\textit{überhaupt}-marked questions behave systematically different from \textit{ba}-interrogatives in that \textit{überhaupt}-questions do not require the precondition of the addressee’s commitment as well, and hence they do not exhibit unfriendly effects, parallel with \textit{a}-questions in Mandarin. Moreover, \textit{überhaupt} can be used to challenge the standard existential presupposition in (33), while \textit{ba} cannot.

(33) A: \textit{Hat der König von Frankreich eine Glatze}?
A: Is the King of France bald?
B: *Hat Frankreich überhaupt einen König?*
B: Does France even have a king? \( \text{(Rojas-Esponda 2014: 30)} \)

\[ (34) \]
A: *faguo guowang shi tutou ma?*
A: Is the King of France bald?
B: *# faguo youmeiyou guowang ba?*
B: Does France even have a king?

Similar presupposition-challenging effects can also be found with English *even*. The difference between (33) and (35) is that what is challenged in (35) is rather A’s assumption of B’s knowledge of the proper name *Oleana*.\(^6\)

\[ (35) \]
A: Let’s meet at Oleana for dinner. Is that okay?
B: What is that *even*? \( \text{(Iatridou and Tatevosov, 2016)} \)

Again, *ba* cannot fit in the scenario in (35) which is felicitous for *even*.

\[ (36) \]
A: Let’s meet at Oleana for dinner. Is that okay?

# shenme shi Oleana ba?
what is Oleana Ba

‘What is Oleana?’

Here, for (33) we assume that the question *is the king of France bald?* is asked at that point and hence is put on the Table, but the presuppositions have not yet been checked or accommodated - so they are not yet in the Common Ground. Therefore, there is no conversational crisis happening when the other person questions the presuppositions (i.e. the exhaustification condition is not satisfied). In the cake sequence in (9), by contrast, the speaker A has already been playing along the QUD for a while, and thus it is very clear that the presuppositions of the QUD have been accepted for the purpose of that conversation. The contrast also implies that it is very important that there is an intermediate step in our model where the interrogative meaning is on the Table but its presuppositions need not yet be in the Common Ground.

\(^6\)It is worth noting that there is some scenario where both *ba* and *even* are felicitous. Consider the following scenario (thanks to Hazel Pearson for bringing this up and creating the scenario):

\[ (1) \]
[ It’s Friday today. B plans to go to A’s place for dinner during the weekend, but they haven’t decided on the date. B is usually very unreliable.]
A: When do you plan to come?
B: Tonight.
[Friday night]
B: Sorry I cannot make it tonight. I will come tomorrow.
[Saturday night]
B: Sorry I have some emergency to deal with. I will come tomorrow.
[Sunday night]
B: I am so sorry but I cannot come today.
A: Do you *even* plan to come?!/Do you plan to come *ba*? 
5. Conclusions

In this paper, I have discussed the usage of Mandarin particle *ba* in interrogatives, which typically generates the “unfriendly” effect. I have shown that *ba* is sensitive to the discourse hierarchy (d-trees): it can only attach to the QUD or presupposition-challenging questions. I proposed that a *ba*-interrogative carries two preconditions by which it (i) indicates a conversational crisis, and (ii) records the source of commitment so that it identifies who to “blame”. The paper also contributes to the discussion of presupposition-challenging particles.

For future directions, the first important question to ask is whether we can unify the uses of *ba* in declaratives and interrogatives. Secondly, it is still not clear why *ba* is sensitive to the QUD, which will also be an interesting question to investigate. Lastly, it seems that *ba* also interacts with different intonation contours in Mandarin (such as rising or falling), which opens another exciting field for us to explore.

References


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**Verbal negation**
Léo ZARADZKI — Laboratoire de Linguistique Formelle, Université Paris Diderot

**Abstract.** While it is well–known that negation has various behaviours, I focus here on verbal negation, a constituent negation acting on verbs. I show that propositional negation and verbal negation are barely distinguishable at matrix level, but that a real semantic difference is brought out in certain linguistic contexts, including direct perception reports. I link verbal negation with counter–expectation and active inaction, thus generalising previous accounts on negated infinitives in direct perception reports. I then propose a formalisation in a recent event semantics framework. Finally I explore how these ideas relate with previous studies in two languages featuring several negation forms: Korean and Bengali.

**Keywords:** non–propositional negation, event semantics, negative events, direct perception reports.

1. Introduction

Negation has been argued many times to have various behaviours. There are reasons to think that negation is not just one operator (e.g. the boolean operator on truth values), but has different facets. Syntactically, in addition to propositional negation, there exist a whole range of constituent negations, acting on nouns, adjectives, adverbs, etc. Semantically, there have been never–ending disputes about the meaning of mere propositional negation (Horn, 1989). Pragmatically, negation can focus on implicatures or presuppositions. Horn (1989) calls this metalinguistic negation, and Geurts (1998) shows that even this has diverse and irreconcilable forms. Some languages also have expletive negation, a negation marker whose semantic contribution seems essentially inert.

One special feature of negation has been observed with negated infinitives under perception reports, as in:

(1) a. John saw Mary not smoke.  

These sentences might seem strange out of the blue, but there is corpus evidence that they occur in text and conversation (Miller, 2007; Miller and Lowrey, 2003) and are often associated with a prior expectation for the negated situation to happen. Below I review a few accounts associated with this phenomenon. For now, suffice it to say that most of them treat it as a distinct use of negation.

In this article, I argue that it is actually part of a more general use of negation, that I call verbal negation: given a predicate $P$, one can reify a new predicate $\overline{P}$ that can in turn be used in positive sentences. This is thus another constituent negation operator, taking scope over predicates and not propositions. Since the verb is seen as the kernel of a sentence, verbal and propositional

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2In all the article, propositional negation refers to a standard negation operator taking scope over the whole proposition and reversing its truth–value.
negation may be considered to be identical. I will present syntactic and semantic evidence that this is not the case.

To be exact, I will argue that at matrix level propositional negation and verbal negation have a very close — if not identical — meaning. However, divergences appear when the negated sentence is embedded in certain linguistic contexts. This is reminiscent of Dretske’s work about contrastive statements (Dretske, 1972), where he shows that “if C(U) is a linguistic expression in which U is embedded, and U can be given different contrastive foci (say U₁ and U₂ [which are not distinguished in terms of truth–values]), then it often makes a difference to the meaning of C(U) whether we embed U₁ or U₂”. Using this methodology, I will describe several linguistic constructions C, including direct perception reports, in which the difference between \( \neg P(x) \) and \( P(x) \) is brought out — in the case of direct perception reports, the propositional reading of negation is just blocked. This will be section 2 of the article. In the third section, I introduce verbal negation and I show that its meaning has to do with counter–expectation, oppositeness and what I call active inaction. Section 4 proposes a formalisation in event semantics; more precisely I will use a variant recently proposed by Bernard and Champollion (2018). Section 5 explores verbal negation cross–linguistically, looking at Korean and Bengali. Finally section 6 is a sketch of an extension to nominal negation.

2. Where propositional negation does not suffice

In this section I enumerate several linguistic constructions in which negation shows an odd behaviour if it is to be analysed as propositional. This will constitute the evidence for verbal negation’s existence that I will use in turn to refine verbal negation’s semantics.

2.1. Direct perception reports

If negation of infinitives under perception reports like in (1a) is propositional negation, then this sentence should mean something like “John saw that Mary was not smoking” or “John saw Mary do something which was not smoking” or, as some authors have proposed⁴ “John saw Mary do something incompatible with smoking”. However this is not satisfactory to the extent that (1a) has been argued to carry something more — for instance Mary’s refraining from smoking (Miller, 2007) — which is absent in those alternative sentences. A plausible context for uttering (1a) would be one where, although aware that Mary smokes like a chimney, John spent a whole evening in her company without her lighting a single cigarette. Maybe she was nervous and made efforts not to smoke. At any rate this construction seems to always be associated with a strong expectation for the predicate under negation to happen.⁴ There have been attempts to explain which eccentric behaviour of negation here could explain the data.⁵

As far as I know, the most detailed formalisation is Cooper’s, in situation semantics (Cooper, 1997). Cooper analyses (1a) as \( s \models \text{see}(j,s') ∧ s' \models \neg \text{smoke}(m) \), where \( s \models p \) means that the situation \( s \) supports the positive infon \( p \). Then Cooper gives two necessary conditions for the same relation with a negative infon to hold:

1. \( s \models \neg \phi \rightarrow \exists(\text{positive})\psi \ [s \models \psi \land \psi \Rightarrow \neg \phi] \)
2. \( s \models \neg \phi \rightarrow \exists(\text{positive})\psi' \ [s \models \psi' \land \psi' > \phi] \)

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³See Miller (2007) for a review.
⁴Or a failure, which is in some sense another form of expectation.
where “the symbol > represents some sort of defeasible inference”, meant to model expectation. However Cooper does not explain what he means by defeasible inference, and is pursuing there the view that infons are intrinsically positive or negative, independently of the way they are described — a view that is philosophically controversial. Moreover these two conditions are only necessary conditions and do not state proper truth conditions for $s \models \neg \phi$, and no compositional treatment is provided.

All these problems vanish if we adopt an account, as proposed hereby, where “not smoke” is just a (positive) predicate, admittedly constructed from negation and another predicate.\(^5\) The counter–expectation flavour becomes thus the verbal negation operator’s task, and the sentence is now a standard direct perception report, just as “John saw Mary smoke”. In other words counter–expectation is now due to using verbal negation, not to the combination of negation with direct perception reports. The difference may seem slight, but it will allow us to generalise this counter–expectation phenomenon to plenty of other linguistic constructions, as described below, without having to distinguish two meanings for them depending on whether they are filled with a positive or a negative predicate.

There actually seems to be subtle variations as to what negation under direct perception report can express. Let me give one more example, which comes from the Internet and is reported by Miller and Lowrey (2003).

\[(2) \quad \text{Elle, son café, elle le fixe. Mais elle n’y voit rien. Elle s’y cache. Furtivement, elle sonde l’homme assis en face. […] Il la regarde ne pas le regarder. Tout sourire. Espigèl. ‘She stares at her coffee, but doesn’t see anything in it. She is hiding in it. She surreptitiously probes the man seating in front. […] He watches her not watch him. All smiles. Impish.’}\]

\[(2)\] suggests that she is making a deliberate effort to avoid watching him. This is what I call active inaction: she is actively not watching him. It is in some sense a form of counter–expectation, to the extent that it would be natural — according to social codes or human cognition, \(\text{e.g.}\) — for her to watch him, \(\text{i.e.}\) we expect her to watch him, and she is going against this expectation. We shall discuss the links between these notions in section 3.

\[2.2. \text{Anaphoric when}\]

Another linguistic context where verbal negation can easily be observed is the anaphoric use of *when*. *When* is non–anaphoric when it makes reference to habits or recurrent causal links as in:

\[(3) \quad \text{When I listen to the Winterreise always my heart is touched and I almost cry.}\]

It is anaphoric when it refers to a single event, as in:

\[(4) \quad \text{When Charles arrived, we listened to the Winterreise.}\]

I here focus on the anaphoric use of *when* combined with negation. Again, sentences thus formed may sound odd, but I will present some actual examples below. First let me give an account for the semantics of *when* in its anaphoric use.\(^6\) Compare the following sentences:

\[\text{This idea is already suggested in Higginbotham (1984).}\]

\[\text{I do not know if it is possible to unify both anaphoric and non–anaphoric uses in one same linguistic token. Some languages use two different words for both uses: for example German has \textit{als} for the anaphoric \textit{when}, and \textit{wenn} for the non–anaphoric \textit{when}. Since this is not relevant to the current issue about negation, I shall leave this question}\]

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\(^{5}\)\(^{6}\)
This morning we entered the motorway in Orange towards Italy.
   a. When we reached Avignon, I turned the radio on.
   b. *When we kept on driving, I turned the radio on.
   c. ?When we reached London, I turned the radio on.

The reason why (5b) is bad is that since we continuously kept on driving, this is not informative enough about the moment the radio has been turned on. As for (5c), if you know that Orange is in the south of France, you would ask why one would make such a detour, for this sentence entails that we did reach London. Therefore when seems to behave exactly as a definite article for time. My account is the following: in a sentence like “When A, B”, when looks for an A–event. If there is a unique A–event e given by the context, then it says that a B–event occurred straight after e. If there is no such event, or several of them, it fails to select. Actually definite articles are able to select even if there are several objects in their target set, as long as one of them is prominent. Anaphoric when imitates them even in this regard, as showed by:

This morning we entered the motorway in Orange towards Italy. When we turned left, I turned the radio on.

which is infelicitous — since there probably are a lot of left curves on the ride — unless one knows that the motorway from Orange to Italy traces some kind of L shape.

All this being said, let me mention that the traditional account for negation in neo–davidsonian semantics assumes that negation means non–existence. Negation acts as an external operator. Thus if a sentence like “It is raining” has logical form  \( \exists e.\ rain(e) \), its negation, “It is not raining”, means just non–existence of such an event: \( \neg \exists e.\ rain(e) \). This explains the contrast:

a. Last night, when he lost his keys, Pierre called a taxi.
   b. *Last night, when he didn’t lose his keys, Pierre called a taxi.

In (7b) indeed, there is simply no event when could refer to. Unfortunately, we do not wish to rule out all the occurrences of negation under anaphoric when, since the following are actual sentences of English: (8) is from an interview with a football manager, after a game where several expected penalties were not given in the first half, but a penalty was given in the second half, while Sergio Agüero, a famous player of the team, was on the bench; (9) comes from the Corpus of Contemporary American English; (10) was found in the fan fiction novel Harry Potter and the Methods of Rationality (thereafter HPMOR) by Eliezer Yudkowsky.\(^8\)

8 All the Harry Potter examples come from this book.
As we will see in section 4.1, Bernard and Champollion (2018) reify what is traditionally an absence of event as a negative event. This allows us to overcome the problem here — \textit{when} can grab these negative events — but the result is not satisfactory even so. Indeed (8) means something like “Sergio was on the pitch the first time that we expected to get a penalty and didn’t” — we find the notion of counter–expectation again, because the penalty should have been given. If negation here was propositional and only meant absence of event, then (8) would rather mean that Sergio was on the pitch the first minute that there was no penalty, period. The same analysis is available with (9): “When I didn’t show up” means “When I should have shown up and I didn’t” rather than “Whenever I was doing something else than showing up”. One may want to argue that this is not a problem: definite articles like \textit{the} are sometimes confronted with a lot of potential referents and still manage to select one, the most prominent in some sense; similarly \textit{when} could select the most prominent \textit{absence of event} it sees. Although it is questionable, due to (6)’s oddness, I know no knockdown argument against this view. Still, I will make the assumption here that this number of negative events is too much of a burden for \textit{when}, and that some other operator — in this case, verbal negation — has first to sort out the relevant events for it. I therefore pursue the view that a big part of what could be attributed to pragmatics in the phenomena studied here is actually due to a semantic feature of verbal negation’s related to the notion of counter–expectation. We will see how it allows to deal with all the phenomena listed in this section.

2.3. Double negation — Excluded middle

Another topic linked with negation and which has been much written about is the law of excluded middle (Horn (1989), Chapter 2). Let me first make a theoretical point. The law of excluded middle together with the principle of non–contradiction entail the law of double negation — \textit{i.e.} for every proposition \(A\), \(A \iff \neg
eg A\). Indeed, \(A \rightarrow \neg
eg A\) holds because if \(A\) is true, \(\neg
eg A\) must be false (otherwise there would be a contradiction), which is what \(\neg
eg A\) means. Conversely, if \(\neg
eg A\) is true, \(\neg
eg A\) cannot be true, therefore \(A\) is true by the law of excluded middle. Even if one rejects the law of excluded middle, the proof still holds for all the propositions \(A\) such that \(A \lor \neg
eg A\) is true. Now negation is a cognitively expensive operator (Tian and Breheny, 2018). For propositions \(A\) for which the law of double negation holds, \(A\) and \(\neg
eg A\) have the same meaning, so since the latter is more expensive,\(^9\) it should be dispreferred. Yet the following examples were produced — all three come from the Corpus of Contemporary American English.

\begin{enumerate}
\item[(11)] — She has long hair. The woman you drew is bald.
— That looks like me. I mean, it doesn’t not look like me. She’s tall, and she has a dog that looks like my dog.
\item[(12)] Zane’s abandoned paperbacks, a few shapeless sweaters we had kept because they fit — or didn’t not fit — us both.
\item[(13)] I don’t have a big diet plan anymore. I watch what I eat, but I don’t not eat a cheeseburger, because life is no fun living on salads and fruit.
\end{enumerate}

In (13) the use of negation may be due to lower cognitive costs in case of direct echoing. Indeed “I watch what I eat” suggests “I don’t eat a cheeseburger”, which is negated. But actually,\(^9\) except for direct echoing
the intended meaning of (13) is rather that it is not the case that I will refrain from eating a cheeseburger when I have this opportunity (active inaction again); it is not quite equivalent to what a version without negation would mean. The same observation can be made about both other examples. For instance in (11), the speaker corrects herself because “that looks like me” would be stronger than “it doesn’t not look like me”, not equivalent.

All this of course reminds the very famous fact that “I don’t like BlackRock” does not mean the same thing as “It is not the case that I like BlackRock”, but is closer to “I dislike BlackRock”. This goes back to Aristotle’s opposition between contraries and contradictories (Horn (1989), Chapter 1). According to Aristotle, negation may express both, depending on the context and the predicate which is negated. Here we thus find another tendency of negation: the tendency to express something opposite (or contrary) rather than complementary (or contradictory). This was already noticed by Higginbotham (1984) about direct perception reports: “I think that negation in Naked Infinitives is generally interpreted as combining with the \textit{VP} to produce an antonymous predicate not–\textit{VP}”.

The analysis I will develop for these double negation examples is thus that a verbal negation is embedded under a propositional negation. This allows to refer to the contrary’s complement of a predicate, as shown in figure 1; an operation for which there is notoriously no word in virtually all natural languages.

Another related violation of the law of excluded middle example is this sentence pronounced by General de Gaulle in a meeting preparing a state visit to USSR, and reported by Alain Peyrefitte in \textit{C’était de Gaulle}:

(14) Je voudrais voir vers où les Soviets sont orientés et ce qu’ils consentiraient à faire, ou du moins, vers où ils sont orientés et ce qu’ils ne consentiront pas à faire.

‘I would like to see where the Soviets are leaning and what they would consent to do, or at least, where they are leaning and what they would not consent to do.’

Here if negation was boolean, the second part of the sentence would be redundant, since knowing what the Soviets consent to do would indicate what they do not consent to do, by complementation. What the General means by “ce qu’ils ne consentiront pas à faire” is rather what they would definitely not do, and does not include the topics on which they are neutral, nor the irrelevant topics, \textit{etc}.

2.4. Other clues

There are several other linguistic contexts where negation has a suspicious behaviour. Unfortunately, listing them exhaustively would require space I do not have here. I will then leave them for a future publication, and only briefly mention a few of them here. Worth mentioning are:
1. the interaction between verbal negation and logical connectors and quantifiers. An example of this is discussed below in (22b).

2. prosodic matters, since some of the sentences become acceptable or acquire a new meaning only with certain prosody, such as a stress, or pronouncing not V as one word. In writing it can be made visible by adding an hyphen. For instance here are two meaningful examples taken from *Harry Potter and the Methods of Rationality*:

(15) I was old enough to know that not–thinking about something doesn’t stop it from happening, so I was really scared.

(16) He was rather startled when he turned back and discovered Hermione sitting down directly beside him at the Ravenclaw table, just as if she hadn’t not–done that for more than a week.

In both cases, the same idea could be expressed by replacing “not–V” with “refrain from V”.

In French, negation is formed with two particles *ne* and *pas* surrounding the verb, or the auxiliary when there is one. In colloquial French, *ne* can be dropped. Moreover, in colloquial French it is possible to add a prefix *re–* to a predicate, to express a reiteration. Here is an example of *re–* applied to a predicate involving negation. It is a spontaneous production of mine. The context is that the car’s battery is empty after a long period without running, and nobody is going to drive the car for a long time in the future either.

(17) De toute façon même si je la charge elle va re– pas rouler pendant un mois après.

‘Anyway, even if I charge it, it is going again to not run for one month.’

The clause can be analysed as [elle va re– [[pas rouler] pendant un mois]]. It carries the idea that it is unusual for the car not to run for such a period. The interaction with time adverbials is interesting too.

3. Related to this, some negative polar questions, asked with the relevant prosody, receive answers as if they were positive:

(18) — Who *did* not–turn–on the light?
    — Théo *did/h’didn’t/ didn’t* do it.

4. Verbal negation reifies new verbs then used in positive sentences. In particular we can observe it together with positive polarity items. Here are a few examples:

(19) Do you still not understand? (HPMOR)

(20) Tu as déjà *pas rendu* un devoir à l’heure?
    You *Aux ever_PPI Neg hand–on–Past a piece–of–homework in time*?

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10As an anonymous reviewer notices, it would be interesting to study the co–occurrence of verbal negation with NPIs. However, the observation should be interpreted carefully, since (propositional) negation is not the only NPI licensor.
‘Did you ever not hand on a piece of homework in time?’

3. Introducing verbal negation

In order to draw the semantic features of verbal negation, let us come back to its use under anaphoric *when*, as examined in section 2.2. Here is example (9) repeated with a pronoun change for the sake of simplicity:

(21) When Hugo didn’t show up for pizza, Coach Tom came looking for him.

According to the analysis of *when* developed above, there must be some event to refer to in the *when*–clause. I posit that some specific behaviour of negation here creates such an event, that I call a negative event: an event of Hugo not showing up. A recent event semantics framework, devised by Bernard and Champollion (2018), makes use of negative events as a formal tool for implementing negation compositionally. These negative events are designed to represent *propositional* negation, and thus do not correspond to negative events in the sense that I want to use them here, but as a matter of fact the framework presents nice features to implement *verbal* negation too. I will introduce Bernard and Champollion’s (thereafter B&C) framework (2018) and the way it deals with propositional negation in section 4.1. For now it will suffice to have in mind the informal description I provided at the end of section 2.2, that is to say, that for any predicate $P$, the lack of a $P$–event during time interval $I$ gives rise to a negative event: a so–called anti–$P$–event. Here I explain why it fails to properly analyse (21) and what verbal negation should look like in this framework. In particular I gather data from section 2 to sketch the meaning of verbal negation. A formalisation within B&C’s framework is proposed in the next section.

As explained in section 2.2, there are too many negative events of Hugo not showing up here\(^{11}\) for *when* to select one. Yet somehow *when* is able to select the moment Hugo was most expected to show up, and then passes it to Coach Tom. In the analysis I develop here, I posit the existence of an operator\(^{12}\) $NEG : V \mapsto \overline{V}$ which, given a verb $V$, reifies a new verb $\overline{V}$ used in turn in positive sentences. In particular $\neg V(x)$ and $\overline{V}(x)$ are going to be two distinct propositions: while propositional negation $\neg$ takes scope over the whole proposition, verbal negation $NEG$ takes scope only over the verb or predicate. At matrix level, negation is ambiguous between a propositional and a verbal reading, and the semantic difference is hardly perceptible. For instance, a sentence like “Eliot didn’t call Max” means, under a propositional reading, that it is not the case that Eliot called Max, while under a verbal reading it sounds rather like “Eliot did [the action of] not call[ing] Max”.\(^{13}\) Although both are very similar and may share the same truth–conditions, it is possible that they are distinguishable — in addition to the counter–expectation flavour I am going to discuss below — in terms of time: the verbal reading refers to a specific time at which there was no calling event, while the propositional reading expresses the absence of such an event at any time. This echoes a phenomenon already observed in Bengali, where Ramchand (2004) argues that two different negation markers reflect exactly this difference in quantification. I will come back to the case of Bengali in section 5.2.

\(^{11}\)At least one for every possible time interval.

\(^{12}\)The upper cases matter, since $NEG$ will denote the verbal negation operator $V \mapsto \overline{V}$, acting on verbs, while $Neg$ will denote the propositional negation operator $A \mapsto \neg A$, acting on propositions.

\(^{13}\)Stressing “did”, marking a brief pause after it and pronouncing “not call” as one word can help this reading.
The difference between propositional and verbal negation is brought out when we embed negation in certain linguistic contexts, such as those presented in section 2, where propositional negation was simply semantically deviant. For instance direct perception reports directly blocks the propositional reading, as we can see through the following comparison:

(22)  
   a. Serge saw that everybody didn’t leave.  
   b. Serge saw everybody not leave.

While the indirect perception report (22a) has been argued to have two readings (universal quantifier appears higher or lower than negation), it is impossible in (22b) that negation occurs higher. I claim that this is because direct perception reports are incompatible with propositional negation, which was the only one able to express such a reading that not everybody stayed. This incompatibility could be due to the fact that absences of events, even reified as negative events, are not, by nature, directly perceptible.

Through the constructions examined in section 2, we saw that negation often had an additional semantic flavour compared to propositional negation. I will propose that this is something encoded in the semantics of verbal negation. However, this additional semantic flavour is not always exactly the same. In broad terms, all the examples I have encountered can be sorted into three categories: counter–expectation, active inaction and oppositeness — some examples belong to several categories.

1. Using $\neg V(x)$ may indicate that there is an expectation for $V(x)$. This includes examples (8), (9), (17), ...

2. When $x$ is a agent gifted with will, using $\neg V(x)$ may indicate $x$’s refraining from $V$, or actively not doing $V$. This is what I call active inaction, because it often involves an effort or concentration in order not to do a natural thing. This include examples (2), (13), (16), ...

3. $\neg V$ may be a predicate meaning something opposite to $V$. This corresponds to Aristotle’s distinction between contraries and contradictories. For those predicates that Aristotle calls mediate, negation can give rise to two meanings: the contrary and the contradictory. Supposing that the former is in fact verbal negation, while the latter is propositional negation, is consistent with the data above. Examples where negation has an oppositeness flavour include (11) or (12).

I do not know how these categories relate with each other. It may be possible to unify them under a single banner of which they are variants. For instance for an agentive $x$ who has the power to $V$ or not, if $V(x)$ is expected and does not happen, it means that it was a deliberate omission by $x$; in other words an active inaction.\textsuperscript{14}

Since this question is a philosophical issue and this article is rather concerned with existence and mechanisms of verbal negation, I will leave it aside for future research. In the rest of the article, I will make the working hypothesis that there is a single characteristic that covers

\textsuperscript{14}A possible unifying explanation, suggested to me by Salvador Mascarenhas, may be that verbal negation expresses the negated predicate’s degree of intensity being high. A slogan for this idea would be: $\neg V$ means “very not $V$”. Where $V$ is a stative predicate, this translates into something opposite to $V$. On the other hand, when $\neg V$ would give rise to punctual events — e.g. under direct perception reports, if one assumes that the verb see with infinitival complement forces the creation of a punctual event — $\neg V$ expresses that there is something extreme going on with this event; possibly, this was an unexpected event.
all three categories mentioned above, and for the sake of simplicity I will call it counter-expectation.

4. Verbal negation in event semantics

In this section, I first give the main features of B&C’s framework (Bernard and Champollion, 2018), and then implement verbal negation in it.

4.1. Negative events and propositional negation

As already mentioned in section 2.2, negation in traditional neo-davidsonian semantics means non-existence. “It is not raining” means just non-existence of a rain event: $\neg \exists e. \text{rain}(e)$. In his Ph.D. dissertation (Bernard, 2019), Bernard argues that this fails to provide a compositional treatment of negation, let alone numerous linguistic phenomena, among which negation under direct perception reports.

A particular feature of B&C’s framework is that it makes use of a special predicate on events, called actual. They introduce it so: “Intuitively, actual events are events that are the case, while non-actual events are conceivable events that are not the case.” (Bernard and Champollion, 2018) It allows among others to refer to events that do not happen, as in “Sabine is tired because she didn’t sleep”. The point is that in this sentence, there is an anti-sleeping–event whose Sabine is the agent, and which caused her tiredness. For each predicate $P$, they define anti-$P$ events as events which preclude every event in $P$. The type $\text{Neg}(P)$ of anti–$P$–events is defined by the following axiom (Bernard, 2019):

$$\exists e \in \text{Neg}(P). \text{actual}(e) \land \tau(e) = I \iff \neg (\exists e' \in P. \text{actual}(e') \land \tau(e') \subseteq I)$$

where $\tau$ is the time–span function which takes an event to the interval of time at which it happened, and $I$ is any time interval. It means that there is an actual anti–$P$–event during $I$ if, and only if, there is no actual $P$–event occurring during this time.

A few words about B&C’s formalism are necessary for what follows. They use a typed $\lambda$–calculus framework. It seems at first glance more complex than standard neo–davidsonian frameworks, but is designed especially to work compositionally with propositional negation. I will use their notation: variables $e, e'$, and so on, are events of type $\nu$, the type of events; $f$ is a variable of type $\langle\nu, t\rangle$, meant to represent, among others, thematic roles (for instance $\lambda e. \text{ag}(e) = \text{Cassandra}$ is the predicate true of events whose agent is Cassandra); a verb $V$ is of type $\langle\langle\nu, t\rangle, \langle\nu, t\rangle\rangle$, abbreviated as $\text{vp}$; and a sentence $S$ is of type $\langle\text{vp}, \text{vp}\rangle$. To cite the example given in Bernard and Champollion (2018), the predicate eat is to be represented by the $\lambda$–term

$$\text{[eat]} = \lambda f. \lambda e. \text{eat}(e) \land f(e)$$

If one wants to say that Cassandra eats, one combines it with the $f$ assigning agentive role to Cassandra, and gets

$$\text{[Cassandra eats]} = \lambda e. \text{eat}(e) \land \text{ag}(e) = \text{Cassandra}$$

15 Even if such a characteristic turns out to have no ontological sense at all, formally nothing prevents one from considering it as the disjunction of several unrelated components.

16 Notice that event is a generic term that embraces here states and other abstract objects, just as Bernard (2019) explains.

17 Why standard neo–davidsonian frameworks are problematic, and why their formalism overcomes these problems, is explained in their article.
The problem now is that there is no more space for additional information — e.g. what she eats — so the authors introduce a silent type–raising operator that will keep new thematic roles available. At the end of a derivation, this silent operator needs to be closed, and it is done by a trivial function $\lambda e. \top$, where $\top$ is the True value. At the top of the derivation there is still a $\lambda e$ channel open, so one puts an existential closure on events.

### 4.2. Implementing verbal negation

Since the absence of (actual) $P$–events still entails the existence of (actual) anti–$P$–events, Axiom 1 leads to a classical behaviour of negation, which is not what we want. As established in section 3 verbal negation $\overline{P}(x)$ means something more than mere absence of $P$–events, and we want only the reverse implication to be valid. A natural thing to try then is to write $NEG(P)$ as $Neg(P)$ plus something more. In this section, I present two possible formalisations of mine based on this idea. Again, the analysis will rest on the when construction.

Recall the account from above: In “When A, B”, the operator when looks for an $A$–event. If there is a unique $A$–event $e$ given by the context, then it says that a $B$–event occurred straight after $\tau(e)$. If there is no such event, or several of them, it fails to select. This can be done by the following $\lambda$–term:

$$\llbracket \textbf{When} \rrbracket = \lambda S. \lambda V. \lambda f. \lambda e. \exists e'. \text{actual}(e') \land S(\lambda e''. \top)(e') \land V(\lambda e'''. \tau(e''') = \tau(e') \land f(e'''))(e)$$

This term takes a sentence $S$ (the $A$–clause), and a verb $V$ (the one in the $B$–clause) and returns a predicate on events $e$ that says that: there was an actual $S$–event $e'$, and $e$ has to be a $V$–event that occurred at the same time as $e'$. The variable $f$ leaves the possibility open to add more thematic roles at higher levels, and a closure operator will fill it at the top of the derivation.

As a first example, having “Hugo showed up” (sic.) represented as the following term:

$$\llbracket \textbf{Hugo showed up} \rrbracket = \lambda f. \lambda e. \text{show}_\text{up}(e) \land \text{ag}(e) = Hugo \land f(e)$$

leads to the following derivation:

$$\llbracket \textbf{When Hugo showed up} \rrbracket = \lambda V. \lambda f. \lambda e. \exists e'. \text{actual}(e') \land \text{show}_\text{up}(e') \land \text{ag}(e') = Hugo \land V(\lambda e'''. \tau(e''') = \tau(e') \land f(e'''))(e)$$

$$\llbracket \textbf{When Hugo showed up, Coach Tom came looking for him} \rrbracket = \lambda e. \exists e'. \text{actual}(e') \land \text{show}_\text{up}(e') \land \text{ag}(e') = Hugo \land come\text{\_look\_for}(e) \land \text{ag}(e) = CT \land \text{theme}(e) = Hugo \land \tau(e) = \tau(e') \land f(e)$$

which, after closure, gives the expected meaning: there is an actual event $e'$ of Hugo showing up, and at the same time there is an actual event $e$ of Coach Tom coming to look for Hugo.

Now if we try to model “When Hugo didn’t show up” with propositional negation, it will fail:

18 You may just ignore this part, as well as the function $f$ argument, I have kept them only to remain consistent with B&C’s system.
19 Recall that $NEG$ is the verbal negation operator, while $Neg$ is the propositional negation operator.
20 Things are complex, and the condition should also include cases where $e$ occurred a very short time after $e'$; since it is not the matter here, I will settle for this simplified condition $\tau(e) = \tau(e')$.
21 See section 4.1
since Hugo never showed up, every time interval $I$ has its own event of Hugo not showing up. This results, according to Axiom 1 in uncountably many events of Hugo not showing up, and when is thus overwhelmed with those and cannot select. I already explained in section 2.2 why this may not be a problem, as it is not for definite articles like the, but I explain here how verbal negation can nevertheless greatly reduce the complexity.

Here is a $\lambda$–term for the verbal negation operator:

$$\boxed{\lnot_{\text{NEG}}} = \lambda V. \lambda f. \lambda e. e \in \text{NEG}(\lambda e'. V(f)(e'))$$

Then:

$$\boxed{\lnot_{\text{NEG}} \text{show up}} = \lambda V. \lambda f. \lambda e. \exists e'. \text{actual}(e')$$

$$= \lambda V. \lambda f. \lambda e. e \in \text{NEG}(\lambda e''. \text{show up}(e'') \land \text{ag}(e'') = \text{Hugo}) \land V(\lambda e''. \tau(e'') = \tau(e') \land f(e''))(e)$$

We now want to give a definition of $\text{NEG}$ precise enough that there is only one (prominent) event of Hugo not showing up. We saw that what restricted the number of negative events described by verbal negation was its counter–expectation feature. A natural thing to try then is to posit a predicate $\text{expected}$ on events. Just as there are actual events and non–actual events, there are expected events and events that are not expected, and this is what $\text{expected}$ reflects. Of course both predicates are different: some expected events turn out to not happen, while some actual events were not expected. Then we can say that there is a $P$–event when there is no actual $P$–event but there was an expected $P$–event:

**Axiom 2**

$$(\exists e \in \text{NEG}(P). \text{actual}(e) \land \tau(e) = I) \iff$$

$$\neg(\exists e' \in P. \text{actual}(e') \land \tau(e') \subseteq I) \land (\exists e' \in P. \text{expected}(e') \land \tau(e') = I)$$

This indeed gives the desired predictions for when. For example, if the pizza party was announced at 8, participants expect Hugo — knowing for instance social codes and Hugo’s punctuality habits — to come by, say, 8.15. Thus there is an expected event of Hugo showing up $e'$ whose time–span is $[8; 8.15]$. Notice that there is no expected event of Hugo showing up with a shorter time–span, for before 8.15 it was still “normal” that he has not arrived yet. Once it is 8.15 participants can conclude that in addition to the expected event of Hugo showing up, there was no actual event of Hugo showing up during this time–span, thus the axiom above tells that there was an actual event of Hugo not$\text{NEG}$ showing up, which just ended. At this point only, Coach Tom came looking for him.22

This makes good predictions for several other constructions we saw in section 2, but it becomes unclear when it comes to double negation. I mentioned that double negation was to be analysed as a verbal negation embedded in a propositional negation.23 Then “I don’t$\text{NEG}$ not$\text{NEG}$ eat a cheeseburger” means that there is no not$\text{NEG}$ eating cheeseburger event, which is equivalent to:

$$\neg\neg(\exists e' \in P. \text{actual}(e') \land \tau(e') \subseteq I) \lor \neg(\exists e' \in P. \text{expected}(e') \land \tau(e') = I)$$

where $P$ here stands for eating a cheeseburger. Since $\neg$ is propositional negation, it is involutive and the formula above can be translated as “I eat a cheeseburger, or it is not the case that I am

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22The careful reader has noticed that according to the when–$\lambda$–term above, Coach Tom looking for Hugo should occur within $[8; 8.15]$ too, and not right after. But the more careful reader will have noticed that footnote 20 acknowledges that this was an imprecise definition of when regarding time–spans.

23more on this point in section 5.
expected to eat one” (where expected is to be taken here in the broad sense described in section 3). For me it is unclear that this is the correct meaning for such a sentence, for then a situation where I actually do not eat the cheeseburger, but was not expected to — for instance because I notoriously hate cheeseburgers — makes the sentence true. If this is the case, then a discourse like this should be coherent:

(23) I have to do my best to stick with my diet plan, but I don’t not eat cheeseburgers, for I don’t like them anyway.

I have no idea whether this discourse sounds weird or can make sense in some contexts, and I believe that at this point experiments should be led to determine whether these double negations agree with the predictions made by Axiom 2. If I am to make a guess, I think that there may be huge variations across sentences, contexts and participants.

Another potential, more conceptual problem with this axiom, is that there is no actual link between \( \overline{P} \)–events and their corresponding expected \( P \)–events. The axiom merely says that there exists an expected \( P \)–event, but does not allow to grab it. But explaining what this expected event consists in is maybe not the role of formal negation, and could be explained by more general pragmatic mechanisms.

A second formalisation, more in line with the arguments developed at the end of section 3, is to posit a (yet unanalysed) property \( F \) of events, meant to express unexpectedness, deliberateness and other related concepts mentioned there. Then the \( \text{NEG} \) operator is simply defined by:

\[
\text{Axiom 3} \quad \quad e \in \text{NEG}(P) \iff e \in \text{Neg}(P) \land F(e)
\]

Coming back to Hugo, if \( F \) is defined so that among all the events of Hugo not\( \text{Neg} \) showing up only one has the \( F \) property (in the situation developed above, it was the one taking place between 8 o’clock and 8.15), then when has got something to select. Moreover, let us check that it derives the correct meaning for double negation. Imagine that François is sick with influenza and the doctor prescribed him to take a nap every afternoon between 2 and 5. Today, he was seen awake at 3. But someone comes to his defence: “François didn’t not sleep from 2pm to 5pm!” Negations in this sentence should be analysed as “François didn’t not\( \text{Neg} \) sleep from 2pm to 5pm]”!

\[
\exists e. e \in \text{Neg}(\lambda e'. e' \in \text{NEG}(\lambda e''. \text{sleep}(e'') \land \text{ag}(e'') = \text{François}) \land \tau(e') = I) \land \text{actual}(e)
\]

which is equivalent, according to Axiom 3, to:

\[
\neg \exists e. e \in \text{Neg}(\lambda e'. \text{sleep}(e') \land \text{ag}(e') = \text{François}) \land F(e) \land \text{actual}(e) \land \tau(e) = I
\]

This means that there is no anti–sleeping–event by François between 2 and 5 which is actual and has the \( F \) property. In other words, either there is no actual anti–sleeping–event lasting from 2 to 5 — i.e. he slept at least a bit during this interval — or there is one, but it does not

\[24\]One way to avoid this may be to modify Axiom 2 into

\[
e \in \text{NEG}(P) \iff e \in P \land \text{expected}(e) \land \forall e'. P(e') \rightarrow \neg \text{actual}(e')
\]

Now the link is direct since the \( \overline{P} \)–event is the \( P \)–event. But then no \( \overline{P} \)–event can technically be actual, which may lead to difficulties I cannot assess, leaving aside the fact that now \( \text{NEG}(P) \)–events are \( P \)–events — a very troubling idea.
not have the \( F \)-property. Thus, as expected, the sentence is true if he slept at least at some point between 2 and 5, or if he was not expected to (the convalescence period is over) — if \( F \) takes an expectation flavour — or if he did not sleep, but tried to and was prevented to by the phone ringing non-stop — if \( F \) takes a deliberateness flavour — or if he did not properly sleep but was somnolent — if \( F \) takes an oppositeness flavour. Having all these truth-conditions in competition of course does not mean that one of them is not to be preferred over the others.

Axiom 3 thus allows us to derive the expected meaning for the uses of verbal negation presented in section 2. These derivations are compositional, since they compositionally use B&C’s compositional framework (Bernard and Champollion, 2018). Note also that as a direct consequence of this definition, verbal negation entails propositional negation, which is a desirable property for the system in view of section 3.

5. Verbal negation in other languages

If propositional negation and verbal negation are truly two different operators,\(^{25}\) then some languages should exhibit a difference visible to the naked eye. In this section I examine the cases of Korean and Bengali.

5.1. Korean\(^{26}\)

Korean has two forms of negation: long form and short form. Syntactically short negation behaves as a constituent negation acting on the verb, while long negation acts on the whole proposition. Examples of long and short negation are shown in (24) and (25) respectively.

    Inho school–to go Neg ha–Past–Decl
    ‘Inho did not go to school.’

    Inho school–to Neg go–Past–Decl.
    ‘Inho did not go to school.’

Short negation uses the preverbal negation particle an, while long negation combines ani with the conjugated light verb ha. There is also a mos form of negation that I will leave aside here. Lee (1993) devotes a chapter to the semantic differences between these negations. There are several ways in which short form and long form can reflect the verbal–propositional opposition. First, short negation takes lower scope than long negation, which suggests that it can behave as a constituent negation on the verb. Second, on the basis of data on imperatives in Korean, which are compatible with long\(^ {27}\) but not with short negation, Han and Lee (2007) argue that the latter, but not the former, is related with negative events or negative states.\(^ {28}\) Third, some authors have associated short negation with “strong volition not to do the denoted action” (McClanahan, according to Lee (2017)), which is reminiscent of active inaction. An enlightening test here is to watch how these negations combine with each other. Han and Lee (2007) attest that cases of double negation are possible, when a long–form negation takes

\(^{25}\)though lexicalised the same in English and other European languages.

\(^{26}\)Most of the facts and examples about Korean come from Han and Lee (2007) or from personal communications from Chungmin Lee and Yun Yeo Jun.

\(^{27}\)with a different lexicalisation

\(^{28}\)The notion of negative event is here to be understood in a more restricted sense than B&C’s.
scope over a short–form negation, as in (26):

     Inho    beer     Neg   drink     Neg do–Past–Decl
     ‘Inho didn’t not drink beer.’

The authors suggest that this is equivalent to the positive form “Inho drank beer”. But native speakers I have asked about this — including one of these two authors — judge that there is a slight difference between (26) and the positive sentence; namely (26) would mean that Inho drank only a little amount of beer, or that he drank it reluctantly. They compared it with a sentence like “Inho doesn’t not like beer”, where the effect of double negation is to take the contrary’s complement, as described at the end of section 2.3. This seems in line with an interpretation of short negation as verbal negation, since it involves notions of volition and oppositeness. Moreover, while combining two short forms together is impossible, my informants declared that combining two long forms is acceptable, and gives rise to a neutral meaning in terms of volition (26) with two long forms would rather have the same meaning as “Inho’s drinking beer happened”), which is again what two propositional negations would produce, though I have no explanation why this construction is acceptable in Korean while it is not in French or English.

5.2. Bengali

Another language worth studying is Bengali. As explained in Ramchand (2004), Bengali possesses two distinct sentential negation markers which occur in different morphosyntactic contexts. These markers are known as na and ni. Ramchand starts from the observation that na hardly appears together with perfect aspect, and explains this in terms of quantification: she follows an analysis where a declarative sentence states that at some referent time, some event happened. According to her, while ni just negates the existence of this referent time at which the event happened, na acts below the time quantifier and negates the existence of the event at this particular time. Here is an example directly taken from Ramchand (2004):

(27)  Ram am–Ta khelo na.
     Ram mango eat–PAST–3RD na
     ‘Ram didn’t eat the mango’
     \exists t : [t < t^*]. \neg \exists e : [t_f(e) = t]. eating(e) \land ag(e) = Ram \land th(e) = the mango

(28)  Ram am–Ta khay ni.
     Ram mango eat–3RD ni
     ‘Ram didn’t eat the mango (at all)’
     \neg \exists t : [t < t^*]. \exists e : [t_f(e) = t]. eating(e) \land ag(e) = Ram \land th(e) = the mango

This explanation accounts for the syntactic deviance of na in the sentences raised by the author. However, as she herself mentions, the interpretation of some of these sentences can actually be forced in some linguistic contexts, which then leads to meanings strangely close to what we observe in English with verbal negation. In the rest of this paragraph I will underline some converging facts, which led me to the (speculative) hypothesis that na may implement verbal

\textsuperscript{29}I have taken the liberty to adapt logical notations to those used in the present article. \(t^*\) stands for the speech time, and \(t_f(e)\) is the ending time of \(e\). (27) and (28) do form a minimal pair; the different forms of the verb are due to an aspectual issue interfering with the negation.
negation in Bengali, while *ni* implements propositional negation. All the examples cited here are directly taken from Ramchand (2004). Let me begin with the following contrast:

(29) tin ghonTa dhore ami kichu boli ni
    for three hours I anything say–1ST *ni*
    ‘For three hours I didn’t say a thing.’

(30) ?tin ghonTa dhore ami kichu bollam na
    for three hours I anything say–1ST *na*
    ‘For three hours I didn’t say a thing.’

The quantification distinction between *ni* and *na* does predict that (29) is the correct form to express this content, while (30) “merely says that at a particular time within that interval, there was no single event of the speaking type”. However, Ramchand concedes that (30) can be interpreted another way: “The only possible reading for this sentence is to have constituent negation of the verb, where the negation is interpreted as describing a positive event of continuously exerting ones will to ‘not speaking’ deliberately for a full three hours”. This is what a verbal negation approach would predict. In the same section, she gives a similar example involving counter–expectation.

Another interesting contrast is the following, which does not need further comments with regard to the discussion in section 2.2 above.

(31) jokhon Mary amTa khel–o [na/*ni], tokhon John khub rege gælo
    When Mary the mango eat–PAST–3RD [nalni], then John very angry got
    ‘When Mary didn’t eat the mango, (then) John got very angry’

In addition, Ramchand signals that “only *na* can be used with non-finite clauses” — which confirms the constituent negation role of *na*, and seems to be in line with my account on direct perception reports. However, all these similarities have been noticed *a posteriori*. In order to establish a proper link between the propositional–verbal opposition and negations in Bengali, additional investigation is needed.

6. Toward nominal negation

Negation of noun phrases has been described as an example of generalised quantifiers. However, as far as I can tell, negation of nouns themselves, as in (32), has been little studied.

(32) Harry didn’t smile. It might have been the most difficult nonsmile of his life.

In this sentence *nonsmile* is used as a common noun, modified by a superlative adjective. But what is the semantic role of this *non–* prefix? It does not seem to be a complement operator among all entities. A dog is hardly a nonsmile. Rather, what the author wants to express here is that Harry had a hard time repressing a smile; in other words, he made a deliberate effort to not smile. This takes us back to verbal negation, since refraining from doing an action was one of its features. We find another feature of verbal negation semantics, counter–expectation, in (33) below. To understand this, one has to know that Harry is here using the pensieve, which is a magical device in Harry Potter’s magical universe. In HPMOR, when you use this device, you can review someone else’s memory from his own point of view. Here Harry is experiencing one memory of Dumbledore’s, which means that he lives the situation as a subjective camera.
(33) Dumbledore’s voice broke, the world tilted as the outlook head fell down into the ancient hands, and awful sounds came from not–Harry’s throat as he began to sob like a child.

In this memory Dumbledore sobbed, so Harry is experiencing this as if himself was sobbing, though through Dumbledore’s body, whence the negation “not–Harry”. Replacing “not–Harry” with “Harry” or with “Dumbledore” in this sentence removes the disconcerting feeling we experience in (33), even if both substitutions give true sentences, in some sense. This suggests that this disconcerting feeling, that reflects the surprising fact that Harry is not in his own body, may be triggered by the use of nominal negation. This would be accounted for by a counter–expectation meaning of nominal negation.

Another interesting example comes from a song by Georges Brassens: *La non–demande en mariage* (the marriage non–proposal). In this song he tells the woman he loves that he does not want to marry her or live with her, but rather remain her “eternal betrothed”. He is thus making a proposal of not marrying (which is more than not making a proposal of marrying). It is in some sense something opposite to a marriage proposal, and this reading is encouraged by the negation in the title.

These three examples illustrate how nominal negation might trigger the same features as verbal negation. Of course all three are literary examples that sound a bit like jokes or puns, as our brain has to do some conscious job to understand them properly, but we are nevertheless able to understand them, which means that there is something for linguistics to explain.

Though I did not investigate this further so far, I believe that this constitutes an easy extension for verbal negation. A natural way to make the connection clear may be nominalisation: in English one can easily form a noun from a verb by adding the –*ing* suffix to it, as in (34b).

(34) a. When did he wash the car?
b. When did the washing of the car take place?
c. When did he not wash the car?
d. *When did the not washing of the car take place?*
e. ?When did the nonwashing of the car take place?

With verbal negation (34a) becomes (34c) and immediately carries a counter–expectation flavour. We can now nominalise the predicate *not wash* and get (34d), which sounds quite awful. Speakers I have interrogated seem to prefer (34e), although they still find it weird. This does not argue for verbal negation being a new verb forming operator, since then one should be able to nominalise the verb *not–wash*, and it should mean barely the same thing as negating the nominalised verb *washing*. Nevertheless *nonwashing* in (34e) does carry this expectation of washing the car, exactly as a verbal negation would.

7. Conclusion

In this paper, I have argued for the need for *verbal* negation, distinct from the familiar propositional negation. Verbal negation has been proposed as a solution to diverse negation puzzles: negated infinitives under perception reports, negation under anaphoric *when* and cases of dou-

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30Here is a context that may help: John works in a bank. His job is to wash the customers’ cars while they are meeting the boss. But he is lazy and sometimes he gets the job done by a friend of his while he himself does something else and enjoys his free time. Today for example he went to the cinema but he didn’t enjoy the film: “It was the most boring nonwashing of my life!”.
ble negation.
I have shown that besides exhibiting the syntactic properties of a constituent negation acting on verbs, verbal negation differentiates itself from propositional negation by clear semantic features, often related to counter–expectation.
At matrix level, negation is ambiguous between a propositional and a verbal reading. However some linguistic contexts can disambiguate it. In particular, I have shown how distinguishing between propositional and verbal negation can reflect the distinction, going back to Aristotle, between contradictories and contraries. I have illustrated how the propositional–verbal distinction may actually be lexicalised in languages featuring several forms of negation like Korean and Bengali. Finally, I have implemented verbal negation within a compositional event semantics framework involving so–called negative events. The system has the desirable property that verbal negation entails propositional negation.
Future work could involve examining how the diverse semantic features presented by verbal negation (counter–expectation, active inaction, oppositeness) relate to each other, and strengthening the tie in with nominal negation as sketched in section 6.

References
Degrees as kinds vs. degrees as numbers: Evidence from equatives

Linmin ZHANG — NYU Shanghai

Abstract. Within formal semantics, there are two views with regard to the ontological status of degrees: the ‘degree-as-number’ view (e.g., Seuren, 1973; Hellan, 1981; von Stechow, 1984) and the ‘degree-as-kind’ view (e.g., Anderson and Morzycki, 2015). Based on (i) empirical distinctions between comparatives and equatives and (ii) Stevens’s (1946) theory on the four levels of measurements, I argue that both views are motivated and needed in accounting for measurement- and comparison-related meanings in natural language. Specifically, I argue that since the semantics of comparatives potentially involves measurable differences, comparatives need to be analyzed based on scales with units, on which degrees are like (real) numbers. In contrast, since equatives are typically used to convey the non-existence of differences, equatives can be based on scales without units, on which degrees can be considered kinds.

Keywords: (Gradable) adjectives, Comparatives, Equatives, Similatives, Levels of measurements, Measurements, Comparisons, Kinds, Degrees, Dimensions, Scales, Units, Differences.

1. Introduction

The notion of degrees plays a fundamental conceptual role in understanding measurements and comparisons. Within the literature of formal semantics, there are two major competing views with regard to the ontological status of degrees. For simplicity, I refer to these two ontologies as the ‘degree-as-number’ view and the ‘degree-as-kind’ view in this paper.

Under the more canonical ‘degree-as-number’ view, degrees are considered primitive objects (of type $d$). Degrees are points on abstract totally ordered scales (see Seuren, 1973; Hellan, 1981; von Stechow, 1984; Heim, 1985; Kennedy, 1999). For example, 6 feet (tall), 5 feet 5 inches (tall), . . . , are degrees, and they are elements of a totally ordered set called ‘height scale’. Thus, degrees are like (real) numbers, and the assumption of abstract totally ordered scales crucially underlies this ‘degree-as-number’ view. As the above-listed non-exhaustive references suggest, the ‘degree-as-number’ view is deeply rooted in the development of research on the semantics of comparatives. Those interval-based analyses of comparatives (Schwarzchild and Wilkinson, 2002; Zhang and Ling, 2015, 2020) are also based on this ‘degree-as-number’ view.

The alternative view, which I dub as the ‘degree-as-kind’ view for simplicity, does not consider degrees primitive objects. Instead, degrees are rather complex objects derived from primitive objects like entities or events. Within this view, degrees have been analyzed as equivalence
classes (Cresswell, 1976), tropes (Moltmann, 2009), or kinds (Anderson and Morzycki, 2015; Scontras, 2017; Luo and Xie, 2018). For example, individuals of the same height are in the same equivalence class, and 6 feet (tall) represents the set of individuals that are 6 feet tall (Cresswell, 1976). In the more subtle version proposed by Moltmann (2009), degrees are constructed out of spatio-temporal-specific instantiations of a property, say the redness of a certain box in front of me, and these instantiations are called tropes. Anderson and Morzycki (2015) draw parallels between individuals and events, using ‘kind’ as a generalized notion to cover properties of individuals (e.g., being 6 feet tall) and events (e.g., crazily (sing) – sing in a crazy manner). Thus, within the broad ‘degree-as-kind’ view, degrees are like properties and based on entities or events, and abstract totally ordered scales are not directly assumed.

Close to the end of their paper, Anderson and Morzycki (2015) ask whether the ‘degree-as-kind’ view can be taken as the ontology of degrees, or whether natural language semantics needs both ontologies for degrees:

Such a dual analysis may provide a way of coping with phenomena such as differential comparatives (one inch taller) and factor phrases (three times taller), where traditional degrees excel. But it would raise the question of why language might have these two systems existing side-by-side, different means to the essentially same end. (Anderson and Morzycki, 2015: Section 6, p. 821)

This paper argues that a dual ontology is indeed motivated. The ‘degree-as-number’ view and the ‘degree-as-kind’ view fundamentally assume different formal properties for measurements and scales, thus leading to different kinds of expressiveness. We need both views to fully account for measurement- and comparison-related meanings encoded in natural language.

More specifically, as summarized in (1), I argue that since comparatives typically encode comparisons resulting in differences and their semantics potentially involves measurable differences, comparatives need to be based on scales with units. For these scales with units, degrees are like (real) numbers. On the other hand, since equatives typically encode comparisons yielding no differences, their semantics can be based on scales without units. For these scales without units, degrees can be considered kinds.

(1) Proposal in a nutshell:

<table>
<thead>
<tr>
<th>Ontologies of degrees</th>
<th>Linguistic constructions</th>
<th>Meanings typically encoded</th>
</tr>
</thead>
<tbody>
<tr>
<td>degrees as numbers</td>
<td>comparatives</td>
<td>comparisons resulting in differences</td>
</tr>
<tr>
<td>degrees as kinds</td>
<td>equatives</td>
<td>comparisons yielding no differences</td>
</tr>
</tbody>
</table>

The current proposal is based on Stevens’s (1946) four levels of measurements and empirically motivated by English and Mandarin Chinese data of comparatives and equatives. Instead of discussing whether degrees are truly primitive objects, I follow Stevens (1946) and focus rather on what formal properties degrees need to be equipped with. At the heart of the proposed dichotomy is the issue of what kind of measurements requires what kind of scales.

In the following, Section 2 presents data of comparisons from English and Mandarin Chinese,
focusing on the distinctions between comparatives and (literal and non-literal) equatives. Section 3 introduces Stevens’s (1946) theory on the four levels of measurements. Section 4 presents the proposal and explains why conceptually and empirically, both the ‘degree-as-number’ and the ‘degree-as-kind’ view are needed. Section 5 sketches a compositional analysis of (Chinese) literal and non-literal equatives. Section 6 concludes.

2. Empirical data of comparisons: comparatives vs. equatives

Comparatives typically express comparisons resulting in differences, while equatives typically express comparisons yielding no differences. Here I use empirical evidence from English and Mandarin Chinese to show further distinctions between them: (i) the compatibility between non-gradable adjectives and equatives is higher than that between non-gradable adjectives and comparatives; (ii) equatives include a subtype that is interpreted in a non-literal way. I will also briefly address an observation with regard to the standard of comparison in these constructions.

2.1. Comparatives vs. equatives: The compatibility with non-gradable adjectives

Within formal semantics, a non-gradable adjective like red is considered a set that only contains things that are red. Thus red is analyzed as a property of type ⟨et⟩, taking an individual x (of type e) as input and returning 1 if x is red (see (2a)). However, a gradable adjective like tall resists being characterized as a property (of type ⟨et⟩) that denotes a set of tall things. We can imagine that a tall man is still much shorter than a short giraffe, and the criterion of being a tall man is also context-dependent and vague. Thus, gradable adjective tall is instead analyzed as a relation between a degree d and an individual x, meaning that the measurement of x reaches the degree d on a relevant scale (here height, see (2b)) (see e.g., von Stechow, 1984; Beck, 2011). The positive (or evaluative) use of tall is derived based on a context-dependent standard for variable d, namely POS (e.g., the height threshold of tall men in a context) (see Bartsch and Vennemann, 1972; Cresswell, 1976; von Stechow, 1984; Kennedy, 1999).

\[
\begin{align*}
\text{a. } [\text{red}]_{\langle et\rangle} & \overset{\text{df}}{=} \lambda x. \text{RED}(x) \quad & \text{Non-gradable adjective} \\
\text{b. } [\text{tall}]_{\langle d, et\rangle} & \overset{\text{df}}{=} \lambda d \lambda x. \text{HEIGHT}(x) \geq d & \text{Gradable adjective}
\end{align*}
\]

It has been widely acknowledged that only gradable adjectives, but not non-gradable adjectives, are compatible with a series of constructions collectively called degree constructions: comparatives, superlatives, degree questions, degree modification, and enough/too-constructions. Examples in (3) illustrate the use of gradable adjective tall in these degree constructions.

\[
\begin{align*}
\text{a. } \text{Brienne is probably taller than Jaime is.} & \quad & \text{Comparative} \\
\text{b. } \text{Brienne is the tallest of all girls.} & \quad & \text{Superlative} \\
\text{c. } \text{How tall is Brienne?} & \quad & \text{Degree question} \\
\text{d. } \text{Brienne is relatively tall, even compared with Jaime.} & \quad & \text{Degree modification} \\
\text{e. } \text{Brienne is tall enough to be a good knight.} & \quad & \text{Enough-construction}
\end{align*}
\]

That being said, however, many non-gradable adjectives can be easily coerced into gradable ones (e.g., based on prototypicality) and thus used in degree constructions (see Rett, 2013;
Morzycki, 2016), as illustrated by the naturally occurring examples found on Google in (4):

(4) a. What could be more non-atomic than a policy involving a sequence of actions 
   ...  
   Comparative
b. The smile on your mouth was the deadest thing.  
   Superlative
c. 75,000 - 100,000 cells are imaged per patch and images analyzed to determine the hexagonality score (how hexagonal is the cell) of each RPE cell.  
   Degree question
d. “It does look quite triangular,” he said  
   Degree modification
e. Modern cryptographic systems generate rather large prime numbers. After generating numbers of a specific length, they run through either the Fermat Primality Test or the Miller-Rabin Primality Test; that way, one knows their numbers are prime enough to be baffling.  
   Enough-construction

These naturally occurring examples show that the use of typical non-gradable adjectives – even adjectives like hexagonal and prime – in degree constructions is attested. Thus the compatibility between a construction and an adjective is not a categorical issue, but rather a matter of degree.

Based on this understanding, I used distributional data from the Corpus of Contemporary American English (CoCA, Davies, 2008) to empirically test the generalization in (5). Specifically, I tested two hypotheses. First, as a canonical degree construction, comparatives are more compatible with gradable adjectives than with non-gradable ones (see the center column in Table (5)). Second, for non-gradable adjectives, they are better compatible with equatives than with comparatives (see the bottom row in Table (5)).

(5) Generalization with regard to compatibility between an adjective and a construction:

<table>
<thead>
<tr>
<th>Constr.</th>
<th>Comparatives</th>
<th>Equatives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gradable adjectives</strong></td>
<td>ADJ.+er than; more ADJ. than</td>
<td>as ADJ. as</td>
</tr>
<tr>
<td>(e.g., taller than, more intelligent than)</td>
<td>(e.g., as tall as, as intelligent as)</td>
<td></td>
</tr>
<tr>
<td><strong>Non-gradable adjectives</strong></td>
<td>Compatibility: + (e.g., redder than, deader than)</td>
<td>Compatibility: ++ (e.g., as red as, as dead as)</td>
</tr>
</tbody>
</table>

I selected 16 typical gradable adjectives (bad, big, broad, cheap, good, great, high, large, long, low, old, short, small, tall, wide, and young) and 16 typical non-gradable ones (American, anonymous, black, blue, brown, dead, French, gray, green, orange, pink, purple, red, round, white, and yellow).  

9It is worth noting that in English, among the adjectives of highest frequencies, most are gradable ones, and
raw counts of their occurrence in comparatives (by searching ‘*er than’ and ‘more * than’) and equatives (by searching ‘as * as’) from CoCA. For simplicity, the attributive use of comparative forms (e.g., a better idea) was not included, which would presumably lead to a lower estimation of the distribution of comparatives (particularly for those containing gradable adjectives), making the testing of the first hypothesis too conservative. However, intuitively, this practice would not affect the investigation of the overall compatibility pattern.

For each adjective, I summed up the counts of its occurrences in ‘*er than’ and ‘more * than’ and divided the sum by its raw frequency, yielding the value of \( p(\text{com}) \). For each adjective, I also divided the count of its occurrence in ‘as * as’ by the raw frequency of the adjective, yielding the value of \( p(\text{eq}) \). The values of \( p(\text{com}) \) and \( p(\text{eq}) \) are available in the Appendix. All the data of raw counts and the values of \( p(\text{com}) \) and \( p(\text{eq}) \) are available in the Appendix. I conducted (I) two two-tailed \( t \)-tests: (i) \( p_{\text{grad}}(\text{com}) \) vs. \( p_{\text{non-grad}}(\text{com}) \), (ii) \( p_{\text{grad}}(\text{eq}) \) vs. \( p_{\text{non-grad}}(\text{eq}) \), and (II) two two-tailed, paired sample \( t \)-tests: (iii) \( p_{\text{non-grad}}(\text{com}) \) vs. \( p_{\text{non-grad}}(\text{eq}) \); and (iv) \( p_{\text{grad}}(\text{com}) \) with \( p_{\text{grad}}(\text{eq}) \).

The first two \( t \)-tests yielded highly significant differences (both \( p < 0.0001 \)), showing that compared to non-gradable adjectives, gradable adjectives are overwhelmingly more likely – about 41 and 7 times more likely on average – to be used in either comparatives or equatives. The crucial third \( t \)-test also yielded a significant difference (\( p = 0.013 \)), showing that for non-gradable adjectives, they are more likely to be used in equatives (\( p_{\text{non-grad}}(\text{eq}) = 0.00142 \)) than in comparatives (\( p_{\text{non-grad}}(\text{com}) = 0.00099 \)). The fourth \( t \)-test also yielded a highly significant difference (\( p < 0.0001 \)), showing that gradable adjectives demonstrate an opposite pattern: they are much more likely – about 4 times more likely on average – to be used in comparatives than in equatives. Thus, together, the results from these two tests suggest that non-gradable adjectives differ from gradable ones in that their compatibility with equatives is much higher (compared to their compatibility with comparatives).

Overall, these results provided preliminary but reliable evidence for the generalization pattern shown in (5). Thus, even though the use of non-gradable adjectives in degree constructions is attested, corpus data suggest that (i) non-gradable adjectives are less compatible with degree constructions than gradable ones are, but (ii) for non-gradable adjectives, their compatibility with equatives is higher than that with comparatives. To sum up, equatives contrast with comparatives with regard to their compatibility with non-gradable adjectives.

2.2. Two subtypes of equatives

Distinct from comparatives, equatives include two subtypes: (i) literal equatives that are interpreted literally, and (ii) non-literal equatives that are interpreted figuratively or metaphorically. Intuitively, (6a) is interpreted literally, parallel to comparatives in that there is a literal overall, there are far more gradable adjectives than non-gradable ones. Thus I had to include some non-gradable adjectives that are not as frequent as the rest of the words. For a more thorough investigation, we can consider using clustering techniques on all adjectives in a language. This is left for future research.

---

10 See the search syntax of CoCA for more details: https://www.english-corpora.org/coca/.
comparison between two values (here Brienne’s and Jaime’s heights) along a single-dimensional scale (here height). Similarly, for (7a), the non-gradable adjective red is coercively interpreted as a gradable one, and two lipsticks’ hues are compared along a single-dimensional scale of redness saturation. (6a) and (7a) are not necessarily positive or evaluative: i.e., (6a) does not entail that Brienne and Jaime are tall, and (7a) can be used to describe two nude lipsticks.\footnote{There is a distinction between tall and its antonym short. (6a) is not evaluative, but Brienne is as short as Jaime is evaluative – it entails that both Brienne and Jaime are short. See Rett (2007) for more discussion.}

In contrast, (6b) and (7b) are non-literal equatives, and they are necessarily evaluative. (6b) does entail that the standard of comparison – mountains – and the sentence subject – Brienne – are both tall, and (7b) entails that both tomatoes and Sam’s face are red. (6b) can be uttered felicitously in a context where Brienne measures 6 feet 6 inches tall, while the height of mountains is in general above 2000 feet. (6b) does not mean that the heights of Brienne and mountains are literally equal, but rather that their tallness gives a similar impression – in a similar manner (i.e., qualitatively similar) and to a similarly impressive extent (i.e., quantitatively similar). Similarly, (7b) does not mean that the redness saturation values of Sam’s face and tomatoes are literally equal, but rather that their redness gives a similar impression, suggesting further that Sam’s face was really red, perhaps due to fury or embarrassment.\footnote{The non-literal equatives (6b) and (7b) are reminiscent of generic equatives, a subtype of similatives. Structurally, equatives differ from similatives (e.g., (i)) in that equatives contain a parameter marker (i.e., the first as in as tall/ red as), while similatives lack one. Semantically, similatives are evaluative. However, compared to literal and non-literal equatives, which always encode a quantitative similarity (e.g., being tall or red to the same extent), similatives seem to encode only a qualitative similarity. See Rett (2013) for more discussions on similatives.}

\begin{enumerate}
\item a. Brienne is \textit{as tall as} Jaime. \hspace{1cm} \textbf{Literal equative}
\hfill \sim \text{ Brienne’s height} \geq \text{ Jaime’s height} \hspace{1cm} \text{(not evaluative)}
\item b. Brienne is \textit{as tall as} a mountain. \hspace{1cm} \textbf{Non-literal equative}
\hfill \sim \text{ Both mountains and Brienne are tall, in a similar manner and to a similar extent.}
\end{enumerate}

\begin{enumerate}
\item a. This lipstick is \textit{as red as} that one. \hspace{1cm} \textbf{Literal equative}
\hfill \sim \text{ the redness saturation of this lipstick} \geq \text{ the redness saturation of that lipstick}
\item b. Sam’s face was \textit{as red as} a ripe tomato. \hspace{1cm} \textbf{Non-literal equative}
\hfill \sim \text{ Both tomatoes and Sam’s face are red, in a similar way and to a similar extent.}
\end{enumerate}

In this sense, non-literal equatives are distinct from genuine, single-dimension-based, degree constructions (e.g., comparatives, literal equatives). Non-literal equatives encode comparisons along some complex dimension, addressing similar extents and similar manners.

In Mandarin Chinese, the semantic distinction between literal vs. non-literal equatives is morphologically manifested. As illustrated by (8) and (9), these two Chinese equative constructions differ with regard to the standard marker (SM). The SM of the gèn-construction (8) is gèn, a morpheme meaning ‘along with’, while the SM of the xiàng-construction (9) is xiàng, a mor-
pheme meaning ‘like, similar (to)’. Semantically, the interpretation of the *gēn*-construction (8) patterns with literal equatives, meaning that the redness saturation values of roses and blood are the same. In contrast, the interpretation of the *xiàng*-construction (9) is parallel to that of non-literal equatives, meaning that the redness of roses and blood gives a similar impression.

(8) mèi-gūi *gēn* xuè yī-yàng hóng
rose along-with blood same red/redder
‘Roses are as red as blood.’ **Chinese literal equative: *gēn*-construction**

(9) mèi-gūi *xiàng* xuè yī-yàng hóng
rose similar/like blood same red/redder
‘Roses are as red as blood.’ **Chinese non-literal equative: *xiàng*-construction**

In terms of evaluativity, *gēn*-constructions are not evaluative, while *xiàng*-constructions are evaluative, as illustrated by the contrast between (10) and (11). In (11), given that Hobbits are short – contrary to the evaluative meaning encoded in the sentence, this equative is infelicitous.

(10) tā *gēn* hā-bǐ-rén yī-yàng gāo
3SG. along-with Hobbits same tall/taller
‘He is as tall as Hobbits.’ ～ **Chinese literal equatives: not evaluative**

(11) # tā *xiàng* hā-bǐ-rén yī-yàng gāo
3SG. similar/like Hobbits same tall/taller
Intended: ‘He is as tall as Hobbits.’ ～ **Chinese non-literal equatives: evaluative**

(12) sums up the empirical generalization here. Crucially, non-literal equatives differ with typical degree constructions like comparatives and literal equatives in a few ways.

(12) Generalization with regard to the interpretation of comparison constructions:

<table>
<thead>
<tr>
<th>Comparison constructions</th>
<th>Degree constructions</th>
<th>Equatives (e.g., <em>as tall as, as red as</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Comparatives</strong></td>
</tr>
<tr>
<td><strong>gēn-constructions</strong></td>
<td></td>
<td>Different extent</td>
</tr>
<tr>
<td><strong>xiàng-constructions</strong></td>
<td></td>
<td>Taller than, redder than</td>
</tr>
<tr>
<td><strong>Evaluativity</strong></td>
<td></td>
<td>Not evaluative</td>
</tr>
<tr>
<td><strong>Adjectives</strong></td>
<td></td>
<td>Graded or coerced non-gradable adjectives</td>
</tr>
<tr>
<td><strong>Dimension</strong></td>
<td></td>
<td>Single</td>
</tr>
</tbody>
</table>
2.3. What can serve as the standard of comparison?

In some languages, e.g., French and Mandarin Chinese, there is also a contrast between comparatives and equatives with regard to items acceptable as comparison standard. Due to space limit, I only present French data, but exactly the same pattern also exists in Mandarin Chinese.

In these languages, for comparatives (see (13)), both individuals (e.g., Pierre) and degree values (e.g., 1.8 meters) can serve as comparison standard. However, for equatives (see (14) and (15)), degree values like 1.8 meters or dark red cannot play the role of comparison standard.

For the examples with non-gradable adjectives in (15), this contrast between blood and dark red also suggests that they are different kinds of semantic objects. Presumably, blood patterns with expressions like Pierre and needs to be analyzed as individuals of type e, while dark red and measure phrase 1.8 meters both belong to the notion of degrees in its broad sense.  

\[(13)\]

a. Marie est \textit{plus grande que} Pierre.
   Mary be.3SG. more tall than Peter
   ‘Mary is taller than Peter.’
   \text{French comparative}

b. Marie est \textit{plus grande qu’} un mètre 80.
   Mary be.3SG. more tall than 1.8 meters
   ‘Mary is taller than 1.8 meters.’
   \text{French comparative}

\[(14)\]

a. Marie est \textit{aussi grande que} Pierre.
   Mary be.3SG. also tall than Peter
   ‘Mary is as tall as Peter.’
   \text{French equative}

b. ?? Marie est \textit{aussi grande qu’} un mètre 80.
   Mary be.3SG. also tall than 1.8 meters
   Intended meaning: ‘Mary is as tall as 1.8 meters.’
   \text{French equative}

\[(15)\]

a. Ce rouge à lèvres est \textit{aussi rouge que} le sang
   this lipstick be.3SG. also red than DET. blood
   ‘This lipstick is as red as blood’.
   \text{French equative}

b. ?? Ce rouge à lèvres est \textit{aussi rouge que} du rouge foncé.
   this lipstick be.3SG. also red than DET. red dark
   Intended meaning: ‘This lipstick is as red as dark red.’
   \text{French equative}

Thus the empirical observations in this section raise three questions. (i) Why are equatives better compatible with non-gradable adjectives than comparatives are? (ii) Why and how are some equatives interpreted in a non-literal way? (iii) Why cannot degree values serve as comparison standard in equatives? Below I will mainly focus on the first two issues.

\[13\] Rett (2015) also points out that in English, equatives formed with a measure phrase (e.g., (ib)) are interpreted distinctly from those formed with a clause as the standard of comparison (e.g., (ia)):

\[(i)\]

a. John can dive as deep as Sue can. \sim \text{the depth that John can dive} \geq \text{the depth that Sue can dive}

b. John can dive as deep as 500 m. \sim \text{the maximal depth that John can dive is 500 m.}
3. Stevens (1946): the four levels of measurements

Before answering the questions raised by the empirical findings and analyzing the ontology of degrees, here I introduce Stevens’s (1946) theory on the four levels of measurements.

Stevens (1946) crucially points out that the notion of measurement, in its broad sense, involves different kinds of mappings between items under measurement and values assigned to them:

... we may say that measurement, in the broadest sense, is defined as the assignment of numerals to objects or events according to rules. The fact that numerals can be assigned under different rules leads to different kinds of scales and different kinds of measurement. The problem then becomes that of making explicit (a) the various rules for the assignment of numerals, (b) the mathematical properties (or group structure) of the resulting scales, and (c) the statistical operations applicable to measurements made with each type of scale. (Stevens, 1946)

Thus, obviously, a measurement can be considered a mapping function. For a given mapping function, all the values that can potentially be assigned to items under measurement are degrees, in the broadest sense of this notion, and moreover, the range of degree values constitutes the scale for this measurement. Then based on the rules of measurement (i.e., types of mapping functions), and relatedly, the formal properties of scales and applicable operations on the degree values resulted from measurement, Stevens (1946) makes a four-level distinction of scales: nominal scales, ordinal scales, interval scales, and ratio scales. As shown by the Venn diagram in Fig. 1, nominal scales are the most general one of these four levels; ordinal scales are a subset of nominal scales; interval scales are a subset of ordinal scales; and ratio scales are a subset of interval scales. Here are some examples illustrating their formal properties.

Nominal scales result from measurements that do not even involve a meaningful ordering, e.g., assigning a postal code to each address. It is in general not meaningful to address the order between two different postal codes – all that matters is whether they are the same or different.
In contrast to nominal scales, ordinal scales have an ordering. For example, given the ranking of my favorite ice cream flavors, it is meaningful to address whether chocolate ranks higher than vanilla. However, beyond this ordering, the scale of ranking cannot address to what extent the 1st ranked flavor exceeds the 2nd ranked flavor or whether the difference between the 1st and the 2nd ranked flavor is the same as that between the 17th and 18th ranked flavor.

Interval scales have not only an ordering, but also units. For example, given a scale of time, due to the notion of units, it is meaningful to address not only that 2 o’clock is earlier than 3 o’clock, but also that the difference between 3 o’clock and 2 o’clock is the same as that between 5 o’clock and 4 o’clock. It is worth noting that o’clock and hour are conceptually different: o’clock is used to mark positions on a scale of time, while hour is used as a unit to measure differences between positions on the scale of time. Crucially, it is the notion of units that supports the further measurement and comparison of differences (e.g., 1 hour) between two positions (e.g., 5:30 and 5:00) along an interval scale (here time), so that we can know to what extent one measurement (here 5:30) exceeds the other (here 5:00) on this interval scale.

Finally, ratio scales are special interval scales that are further equipped with a meaningful, absolute zero point. For example, the temporal length has a meaningful zero point and is thus a ratio scale (cf. a scale of time, which lacks a meaningful zero point and is thus a non-ratio interval scale). On a scale of temporal length, not only we can compare the scalar values 4 hours and 3 hours and address to what extent 4 hours exceeds 3 hours – the difference here is 1 hour, but also it is meaningful to consider the ratio between 4 hours and 3 hours – the ratio here is 1.75, i.e., 4 hours is 1.75 times as long as 3 hours. Obviously, on a scale of time, where there is no meaningful zero point, the ratio between 4 o’clock and 3 o’clock is meaningless.

Previously, based on Stevens’s (1946) theory on the four levels of scales, Sassoon (2010) explains which gradable adjectives can be used along with measure phrases in forming measurement constructions. As illustrated by the contrast in (16), long is compatible with the use of 2 meters, forming a grammatical measurement construction, while short is incompatible with the use of a measure phrase, leading to an unacceptable sentence. The analysis of Sassoon (2010) is based on Stevens’s (1946) distinction between interval scale and ratio scales. Essentially, for measurement constructions, their measure phrase refers to the difference between a measurement (e.g., the length of this rope) and the absolute zero point on the scale. Thus only gradable adjectives (e.g., long, tall) associated with ratio scales (i.e., interval scales equipped with a meaningful, absolute zero point) can be used to form measurement constructions.

(16) a. This rope is 2 meters long.  
    b. *This rope is 2 meters short.

In this sense, Stevens’s (1946) theory on the four levels of scales and their formal properties provides crucial insight on our intuitive knowledge (of mathematics and physics) and how this kind of intuitive knowledge is reflected in our use of natural language.

Following the work of Stevens (1946) and Sassoon (2010), in the following, I also base my proposal for the ontology of degrees on the levels of scales and the formal properties of scales.
4. Proposal: a dual ontology of degrees

As shown in (17), I propose a dual ontology of degrees based on the distinction between scales with vs. without units. These two types of scales have different formal properties, leading to a dual ontology of degrees: those belonging to scales with units and thus behaving like (real) numbers, and those belonging to scales without units and thus behaving like kinds.

As a consequence, for degrees-as-numbers, their scale – the set of degrees – is a totally ordered set with units, supporting the operation of subtraction on degrees along a single dimension (e.g., time, height). In natural language, gradable adjectives (and non-gradable adjectives coercively interpreted as gradable ones) are associated with this kind of ‘scales with units’. The formal properties of these scales and degrees are necessary in the semantic analysis of comparatives and measurement constructions. I will discuss in detail below.

For degrees-as-kinds, their scale is not equipped with units and cannot support the operation of subtraction on degrees. Thus on these ‘scales without units’, differences between degrees are not measurable. Some of these scales might involve a complex dimension, e.g., a combination of hue, saturation, and texture. Both gradable and non-gradable adjectives, when used in natural language constructions involving no measurable differences (e.g., equatives, superlatives (see Solt, 2016)), can be considered associated with ‘scales without units’, and formal properties specially belonging to ‘scales with units’ (for gradable adjectives) are not made use of.

(17) A dual ontology of degrees:

<table>
<thead>
<tr>
<th>Scales</th>
<th>scales with units</th>
<th>scales without units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degrees</td>
<td>like real numbers</td>
<td>like kinds or manners</td>
</tr>
<tr>
<td></td>
<td>(e.g., 1 kg, 3 o’clock)</td>
<td>(e.g., dark red, boyishly tall)</td>
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<td>Differences along the dimension</td>
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<td>not measurable; subtraction is inapplicable</td>
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<td>Adjectives</td>
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<td>not necessarily gradable</td>
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<tr>
<td>Constructions</td>
<td>comparatives: degree constructions with ratios or measure phrases</td>
<td>equatives (including literal &amp; non-literal equatives); superlatives</td>
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</table>

Comparatives containing numeral differentials (e.g., 2 inches in (18a), 1 hour in (18b), 3 cm in (18c)), provide the most direct empirical motivation for the ‘degree-as-number’ view.

(18) a. My giraffe is 2 inches taller than this tree is.
    b. The arrival of the train was 1 hour later than scheduled.
    c. Zhāng-Sān bǐ Lǐ-Sī gāo sān lǐ-mǐ.

Zhāng-Sān STANDARD-MARKER (SM) Lǐ-Sī tall/taller three centimeter ‘Zhāng-Sān is 3 cm taller than Lǐ-Sī’.

Chinese comparative
In particular, as mentioned earlier, in (18b), o’clock is used in marking positions on a scale of time, while hour is used as a unit for measuring differences between such positions. Evidently, equivalence classes like \{3 \text{o’clock}, \ldots \} and \{2:00, \ldots \} can only establish ordering relations and constitute ordinal scales. Without the concept of units for measuring differences (e.g., hour), we can by no means address to what extent \{3:00, \ldots \} is posterior to \{2:00, \ldots \}. In this sense, languages able to express numeral differentials in comparatives all need the ‘degree-as-number’ view to fully account for measurement- and comparison-related phenomena.\textsuperscript{14}

In addition to comparatives containing numeral differentials, the comparison of deviations also lends empirical support for the ‘degree-as-number’ view. As illustrated by the English and Chinese examples (19) and (20), the semantics of these sentences involves three comparisons. For (19), the first two comparisons result in evaluative meanings (i.e., Mona is happy, and Jude is sad), due to the existence of difference between a measurement (e.g., Mona’s happiness) and the context-dependent POS value. Then the third comparison is between these two differences resulted from the first two comparisons. Evidently, ordinal scales cannot support the third comparison here – i.e., the further measurement and comparison of the differences between measurements. The notion of interval scales, and together with it, the ‘degree-as-number’ view and the operation of subtraction, are indispensable in the semantic analysis of (19) and (20).

(19) Mona is more happy than Jude is sad. 
\text{\textasciitilde} [\text{HAPPINESS} (\text{Mona}) - \text{POS}_{\text{HAPPINESS}}] > [\text{SADNESS} (\text{Jude}) - \text{POS}_{\text{SADNESS}}]
\textbf{Comparison 1}: Mona’s happiness vs. POS$_{\text{HAPPINESS}}$ (along the scale of happiness)
\textbf{Comparison 2}: Jude’s sadness vs. POS$_{\text{SADNESS}}$ (along the scale of sadness)
\textbf{Comparison 3}: difference from Comparison 1 vs. difference from Comparison 2 (along the scale of deviation size)

(20) tā duō chǐ de bǐ wǒ shǎo chǐ de duō yī pán
3SG. much/more eat PART. SM 1SG. little/less eat PART. much/more one dish (CL.)
‘The amount that he over-ate was 1 dish more than the amount that I under-ate.’

Finally, naturally occurring examples from COCA (see (21)) argue against the view that ordinal scales would be sufficient for analyzing comparatives containing non-gradable adjectives. Although measurements of redness cannot be naturally associated with number-like values, and numeral differentials can hardly be used along with redder, the use of degree modifiers much and a bit indicates that the notion of measurable differences is still indispensable. Thus, even for non-gradable adjectives, comparatives have to be based on ‘scales with units’, and non-gradable adjectives are necessarily coerced into gradable ones in comparatives.

(21) a. Indeed, such ‘space weathering’ makes the lunar surface much redder than the color of pristine Moon rocks.
b. . . . change exposures and printing filters to make an image a bit redder . . .

\textsuperscript{14}Even for languages in which ‘degreeless comparatives’ are attested, e.g., Mandarin Chinese (see Li, 2015; Luo and Xie, 2018), as far as they also have comparative constructions involving measurable differences, the ‘degree-as-number’ view is still empirically motivated in these languages (see the Chinese examples (18c) and (20)).
In contrast to comparatives, equatives typically express comparisons yielding no differences. Therefore, to analyze equatives, we do not need to consider the further measurement or comparison of differences, because there are none. Consequently, the semantics of equatives does not require ‘scales with units’ or the ‘degree-as-number’ view. All scales, including nominal scales and ordinal scales, can be involved in the semantics of equatives.

This reasoning immediately answers the first question raised in Section 2. Since equatives do not require ‘scales with units’, gradable and non-gradable adjectives are both eligible. Thus, equatives are better compatible with non-gradable adjectives than comparatives are.

Among equatives, the distinction between gên-constructions and xiàng-constructions in Mandarin Chinese means that in a certain language, there can still be additional requirements for the scales involved in some specific types of equatives. The interpretation of gên-constructions in Chinese (see the discussion in Section 2.2) suggests that they are similar to comparatives in involving single-dimensional scales with ordering, i.e., ordinal scales (w/o units). As a consequence, non-gradable adjectives used in gên-constructions are coerced to be associated with ordinal scales, and similar to comparatives, gên-constructions are not evaluative. As a consequence, non-gradable adjectives used in gên-constructions are coerced to be associated with ordinal scales, and similar to comparatives, gên-constructions are not evaluative.15

Unlike comparatives or literal equatives (including gên-constructions), non-literal equatives (including xiàng-constructions) are interpreted in an evaluative and non-literal way. These equatives are compatible with both gradable (see (22a)) and non-gradable adjectives (see (22b)). However, here even gradable adjectives like tall need to be interpreted as associated with a nominal scale, on which degrees are not number-like values, but rather kinds. For (22a), both Brienne and mountains are tall, in the same way and to the same impressive extent. In terms of Stevens’s (1946) theory, the measurement value of Brienne’s height is mountainous tallness, a degree(-as-kind) defined by the feeling of tallness in our conceptual knowledge of mountains. 16

(22) a. Brienne is as tall as a mountain. (= (6b))
   b. Sam’s face was as red as a ripe tomato. (= (7b))
   c. #A mountain is as tall as Brienne.

This analysis answers the second question raised in Section 2. Degrees on nominal scales are not necessarily as single-dimensional as numbers. The non-literal, figurative reading is due to invoking a complex dimension. In interpreting (22a), it is our conceptual knowledge of mountains that leads to the specific definition of a complex-dimensional degree value, which probably combines height, strength, and firmness. In this sense, degrees-as-kinds are distinct from equivalence classes defined as a set of items sharing the same value along a certain scale (see e.g., Cresswell, 1976). The ‘degree-as-equivalence-class’ view predicts that the semantics of equatives is symmetric, but this prediction is clearly not borne out: (22a) is felicitous, but intuitively, (22c) sounds weird. The sentences in (23) are also interpreted differently, because our conceptual knowledge of blood and roses leads to different kinds of redness.16

15Solt (2016) accounts for the distinction between most and more than half in a similar measurement-based way: the superlative form is based on ordinal scales w/o units, while the comparative form involves interval scales.
16See Percus and Sharvit (2014) and Zhang (2016) for more discussions on the semantic asymmetry and symmetry in related constructions, e.g., the use of same and sentences like The morning star is the evening star.
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(23)  
a. Roses are as red as blood. Degree(-as-kind) value: bloody red
   \[ \sim \] Roses give an impression of dazzling, horrible redness as blood typically does.

b. Blood is as red as roses. Degree(-as-kind) value: rosy red
   \[ \sim \] Blood gives an impression of energetic, bright redness as roses typically do.

To sum up, I have argued that both the ‘degree-as-number’ and the ‘degree-as-kind’ view are conceptually necessary and empirically motivated. Based on Stevens’s (1946) theory of the four levels of measurements, this dual ontology of degrees explains both the core of the notion of degrees – they are values of a certain scale for measurement (in its broad sense) – and the various kinds of expressive potentials related to the uses of adjectives in natural language.

5. Analyzing equatives: Chinese gên-constructions and xiàng-constructions

Based on the dual ontology of degrees, I sketch a formal compositional analysis of literal and non-literal equatives (or more generally, single- vs. complex-dimensional comparisons). Since Chinese makes a morphological distinction (i) between these two subtypes of equatives and (ii) between the parameter marker (PM – the first as in as tall as X) and standard marker (SM – the second as in as tall as X), the analysis is based on Chinese lexical items for clarity.

The basic idea is that an adjective provides a (single- or complex-dimensional) scale for measurement and can be analyzed as a measure function, mapping an item to its measurement (see also Kennedy 1999). The use of an adjective in different linguistic constructions makes it associated with different scales: domains like \( D_d \), i.e., a domain of number-like values on which subtraction is applicable (see (24a)); or \( D_k \), i.e., a domain of kind-like items (see (24b)).

\[ \text{[[tall / gāo]]_{(e,\delta)} \defeq \lambda x.\text{HEIGHT}(x) \quad (\delta \in \{d,k\}) \]  
(Context: Brienne is 6’6” tall. Her tallness is reminiscent of strength and firmness.)

a. On an interval scale: \( \text{HEIGHT-NUMBER}_{(ed)}(\text{Brienne}) = 6’6” \)
b. On a nominal scale: \( \text{HEIGHTT-KIND}_{(ek)}(\text{B}) = \text{BRIENNE’S KIND OF TALLNESS} \)

In positive, measurement, and comparative constructions, tall is associated with an interval scale (see (25)). These constructions mean that the measurement of the sentence subject (i.e., the target of predication) reaches a certain degree along an interval scale. Thus I use a type-shifter \( \lambda G.\lambda M.\lambda x.G(x) \geq M \) to generate sentential semantics. In particular, the derivation of comparatives (see (25c)) is directly based on subtraction, an operation requiring interval scales (see Zhang and Ling, 2020 for details on the implementation of subtraction).

\[ \text{[[Brienne is tall]]} \iff [\lambda G.\lambda M.\lambda x.G(x) \geq M]([\text{tall}])\text{(M}_{\text{POS}}(\text{[[Brienne]]}) \]  
\[ \iff \text{HT-NUMBER}(\text{Brienne}) \geq M_{\text{POS}} \quad (M_{\text{POS}}: \text{a contextual threshold for being tall}) \]

b. \[ \text{[[Brienne is 6 feet 6 inches tall]]} \iff [\lambda G.\lambda M.\lambda x.G(x) \geq M]([\text{tall}])\text{(6’6”)}([\text{Brienne}]) \]  
\[ \iff \text{HEIGHT-NUMBER}(\text{Brienne}) \geq 6’6” \]

c. \[ \text{[[Brienne is 2 inches taller than Jaime is]]} \quad ([\text{-er}]: \text{an unspecified positive value}) \]  
\[ \iff [\lambda G.\lambda M.\lambda x.G(x) \geq M]([\text{tall}])\text{([2 inches -er \ldots than Jaime is tall])}([\text{Brienne}]) \]  
\[ \iff \text{HEIGHT-NUMBER}(\text{Brienne}) \geq 2\text{M} - \text{HEIGHT-NUMBER}(\text{Jaime}) = 2” \]
In expressions like *that tall* (see Anderson and Morzycki 2015) and *literal and non-literal equatives*, adjectives are associated with a nominal scale that is potentially complex-dimensional (an ordinal scale is considered a special case—a single-dimensional scale with an ordering (see Fig. 1 and the table in (17))). On a nominal scale, [[tall]], as a measure function, maps an entity to a degree-as-kind—a certain kind of tallness. Suppose Brienne’s tallness involves strength and firmness, and here that—a free variable of kind—denotes firmness. Then (26) is intuitively true. Thus I propose to use a type-shifter ‘λ.G.λ.M.λ.x.G(x) ⊑ info M’ to generate sentential semantics. I do not go into formal details of ‘⊆ info’ in the current paper. Informally, ‘⊆ info’ means that a kind (e.g., Brienne’s kind of tallness) entails (i.e., is more informative than) another.

(26) [[Brienne is that j tall]] ⇔ [λ.G.λ.M.λ.x.G(x) ⊑ info M]([[tall]])(s_j)([[Brienne]])
⇔ HEIGHT-KIND(Brienne) ⊑ info s_j (s_j: a free variable meaning some kind of tallness)

The critical lexical items in equatives are (i) the PM yi-yàng and (ii) the SMs xiàng and gén. Essentially, gén/xiàng generates a definite degree-as-kind that serves as comparison standard in equatives. In this sense, the gén/xiàng-phrase/clause addresses a how question, abstracting an entity or event into a degree-as-kind. The distinction between gén and xiàng hinges on whether this degree-as-kind is along a single- or complex-dimensional scale (see (27)). Thus the semantics of a generic equative can be naturally derived: (28) expresses qualitative similarity.17

(27) [[gén/xiàng (SM)]]_{(kt.k)} def = λ.D_{(kt)},.d[D(d) ∧ d′[D(d′) ∧ d ≠ d′ → d ⊑ info d′]]
a. [[gén]]_{(kt.k)} (λ.d.Jaime is d-tall) = Jaime’s kind of tallness 〜 tallness
b. [[xiàng]]_{(kt.k)} (λ.d.Jaime is d-tall) = Jaime’s kind of tallness
〜 a combined kind of tallness, strength, masculinity, etc.

(28) [[Brienne is tall asSM/xiàng a mountain]] Similative (generic equative)
⇔ [λ.G.λ.M.λ.x.G(x) ⊑ info M]([[tall]]) ([[as a mountain is-tall]]) ([[B]])
⇔ HEIGHT-KIND(Brienne) ⊑ info the kind of tallness that a mountain has

On top of this qualitative similarity, yi-yàng further expresses similarity in terms of extent. I propose that kinds (of type k) can be further measured by measure functions of type (kd). In (literal and non-literal) equatives (see (30) and (31)), [yi-yàng] relates three items, an adjective G, a comparison standard M (which is a certain kind), and an entity x (see (29)), meaning that for any measure function P that can be used to measure M, P can also be used to measure G(x) (i.e., in terms of kind, G(x) ⊑ info M), and when measured by P, G(x) is to at least the same extent as M (i.e., P(G(x)) ≥ P(M)). Obviously, when G(x) and M are kinds on a single-dimensional scale (i.e., in literal equatives), the comparison results in just extent similarity (see (30)). (31) shows that a non-literal equative expresses similarities on both kinds and extents.

(29) [[yi-yàng (Parameter marker)]]_{(ek,(k,ef))} def = λ.G_{(ek)}.λ.M_k.λ.x_e.
\forall P_{(kd)} [P(M) is defined → P(G(x)) is defined ∧ P(G(x)) ≥ P(M)]

17As suggested by the example (27a), the use of gén sounds somehow vacuous. Indeed, for Chinese literal equatives, sometimes gén is optional: e.g., Brienne (gén) Jaime yi-yàng gào. Moreover, in Chinese, gén cannot be used to form a generic equative (cf. (28)). Presumably, the semantics of a generic equative and the expression of qualitative similarity (e.g., sharing the same kind of tallness) must be based on complex-dimensional scales.
The current analysis also answers the third question raised in Section 2: directly inserting a degree value into the standard position in these equatives leads to a type-mismatch. This is not really a stipulation, because equatives essentially mean the sharing of kinds/ extents between items, not just using degree values (kinds or numbers) to characterize the target of predication.

6. Conclusion

This paper argues for a dual ontology of degrees. Degrees, in the broadest sense of the term, are elements of a certain scale for measurement (Stevens, 1946). Therefore, degrees of ‘scales with units’ are like numbers and support the application of subtraction, while degrees of ‘scales without units’ can be considered kinds that potentially involve a complex-dimensional measurement or characterization. Empirically, this dual ontology of degrees is motivated by various kinds of natural language phenomena, especially comparatives containing numeral differentials (for the ‘degrees as numbers’ view) and non-literal equatives (for the ‘degrees as kinds’ view). The formal properties of relevant scales underline the expressiveness of these linguistic constructions. One issue on which I have not gone into detail is the formal description of a complex dimension and the informativeness relation between two kinds (e.g., Brienne’s tallness that involves firmness and strength vs. just firmness). This is related to the issue of ‘combined scales’ in the literature (see Bale, 2020). A thorough investigation on this is left for future research. More broadly, this project is related to the semantics of similatives and metaphors. The investigation of the whole spectrum from equatives to metaphors is also left for another occasion.

References


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**Average** | **0.04063** | **0.00982** | **0.00099** | **0.00142**
**SD** | **0.02147** | **0.00716** | **0.00061** | **0.00078**

**Appendix:** Table of raw counts of strings in CoCA and the proportions of comparatives and equatives

\[
p(\text{com}) = \frac{\text{Count}(\ast \text{ER THAN}) + \text{Count}(\text{MORE} \ast \text{THAN})}{\text{Count}([*])};
\]
\[
p(\text{eq}) = \frac{\text{Count}(\text{AS} \ast \text{AS})}{\text{Count}([*])}.
\]

**Test 1 – two-tailed t-test** \(p_{gr}(\text{com})\) vs. \(p_{n-gr}(\text{com})\): \(p < 0.0001\)

**Test 2 – two-tailed t-test** \(p_{gr}(\text{eq})\) vs. \(p_{n-gr}(\text{eq})\): \(p < 0.0001\)

**Test 3 – two-tailed paired-sample t-test** \(p_{n-gr}(\text{com})\) vs. \(p_{n-gr}(\text{eq})\): \(p = 0.013\)

**Test 4 – two-tailed paired-sample t-test** \(p_{gr}(\text{com})\) vs. \(p_{gr}(\text{eq})\): \(p < 0.0001\)
Generalized incrementality: The veridicality property of clause-embedding reveal-type predicates in Polish

Karolina ZUCHEWICZ — Leibniz-Zentrum Allgemeine Sprachwissenschaft
Luka SZUCSICH — Humboldt-Universität zu Berlin

Abstract. It is a common observation that the so-called incremental theme verbs like ‘eat’, ‘drink’ or ‘build’ enforce a gradual affectedness of a direct object by the verbal process (Dowty, 1991; Krifka, 1992 among others). In aspect languages like Polish, perfective incremental theme verbs imply a total affectedness: The object vanishes (in the case of ‘eat’ or ‘drink’), it appears in its totality (in the case of ‘build’) or is fully involved in any other way (for example in the case of ‘read’, where there are no unread pages left in a single reading event). In contrast, imperfective counterparts only imply partial affectedness of their objects (Wierzbicka, 1967; Filip, 1985, 1997, 1999; Krifka, 1989a, 1989b, 1989c, 1992). Crucially, the gradual-total affectedness relation between the verb and its object only holds for incremental theme verbs. For instance, seeing a sandwich, in contrast to eating a sandwich, neither changes anything in the structure of a sandwich nor does it necessarily relate to its parts. This paper shows that propositional objects are also subjected to verbal events in a gradual manner if a clause-embedding verb is an incremental theme verb. In this case, the counterpart to total affectedness is veridicality, i.e. the revelation of a truth-conditional object. Building upon Zuchewicz (2020), we propose an account of generalized incrementality. In this account, incrementality is defined on the level of events and does not enforce the object to be divided into parts (compared to Krifka, 1989a, 1989b, 1989c, 1992 among others). As a result, the analysis holds for all incremental theme verbs, regardless of the type of a complement they combine with. The justification for this line of reasoning comes from a diverse nature of incrementality. Our object of investigation are transitive verbs which, if realized by clause-embedding predicates, take a that-clause as a complement. Their incremental character cannot be captured by dividing a proposition expressed by a that-clause into parts, but by a gradual creation of a proof for an embedded proposition.

Keywords: aspect, Polish, perfectivity, veridicality, truth-entailment, clause-embedding predicates, incrementality.

1. Polish aspectual system

Before moving on to the aspect-dependent interpretation of nominal and clausal complements in Polish, we will briefly describe the Polish aspectual system.

In Polish and in other Slavic and some non-Slavic languages, most verbs build aspectual pairs. As a result, almost all events can be seen from two perspectives, depending on the (im)perfective marking on the stem: They can be viewed as temporally delimited if described with a perfective verb, or as temporally unlimited if described with an imperfective counterpart. Only imperfective verbs can be arguments of phasal verbs like ‘begin’ or ‘finish’ (the so-called

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aspectualizers, cf. Verkuyl, 1999), as example (1) illustrates (cf. also Zuchewicz, 2020 or Borik, 2002 for Russian).

(1) Jan zaczął / skończył budować / #zbudować
Jan started.PFV / finished.PFV build.IPV / build.PFV
szałas / śpiewać / #zaśpiewać hymn.
hut / sing.IPV / sing.PFV national.anthem
‘Jan has started/has finished building a hut/singing the national anthem.’

The aspect of phasal verbs does not influence the above pattern, compare (2).

(2) Jan zaczął / kończył budować / #zbudować
Jan started.IPV / finished.IPV build.IPV / build.PFV
szałas / śpiewać / #zaśpiewać hymn.
hut / sing.IPV / sing.PFV national.anthem
‘Jan was starting/finishing building a hut/singing the national anthem.’

Temporal delimitation of verbs that are under the scope of the perfective aspect always implies some sort of completeness. Completeness can have different realizations, depending on the way delimitation is expressed. In the next section, we will discuss some of those realizations. We will concentrate on the orientation on the completion of an entire event with a gradual/total affectedness of a direct object, which are restricted to incremental theme verbs.

2. Aspect and the interpretation of nominal arguments

2.1. Aspect-dependent interpretation of a direct object

As was mentioned before, the interpretation of a direct object argument under (im)perfective aspect depends on the semantic class a verb belongs to (cf. for instance Krifka, 1989a, 1989b, 1989c, 1992; Filip, 2005; Szucsich, 2005). Compare the following Polish examples of motion verbs.

(3) Jan przytargał worek ziemniaków.
Jan lugged.PFV sack potatoes.of
‘Jan has lugged a sack of potatoes.’
Implication: A sack of potatoes reached its destination.

(4) Jan targał worek ziemniaków.
Jan lugged.IPV sack potatoes.of
‘Jan was lugging a sack of potatoes.’
Implication: A sack of potatoes did not necessarily reach its/any destination.

The difference between (3) and (4) lies in the success of reaching a location by the object. In (3), where the perfective verb is used, the sack of potatoes reached its destination. The sentence cannot be continued with ‘but he (Jan) did not bring it finally’. In (4), however, Jan and the sack of potatoes were covering some implicit non-finite path (cf. Filip, 2005; Zuchewicz,
2020), but it is left open whether they have reached any goal; moreover, there need not be any goal at all. It can be the case that Jan was carrying the sack of potatoes just for fun. Therefore, the sentence can be continued with ‘but he (Jan) did not bring it finally’. Crucially, there is no gradual relation between the progress of the process of carrying and the affectedness of the object. The structure of potatoes does not change during this process either independently of the aspectual marking.

Another example for the lack of the direct and gradual affectedness of the object by the verbal process is that of perception verbs. Consider a minimal pair (5) and (6).

(5) Jan usłyszał dziecko / poczuł deszcz.
Jan heard.PFV child / felt.PFV rain.
‘Jan has heard a child / has felt the rain.’
Implication: Jan started hearing a child/feeling the rain. There was a specific event of Jan’s hearing a child/feeling the rain.

(6) Jan słyszał dziecko / czuł deszcz.
Jan heard.IPFV child / felt.IPFV rain
‘Jan heard a child / felt the rain.’
Implication: Jan heard a child’s voice/feeling the rain for some period of time (and maybe he still hears it/feels it at the utterance time).

In (5) and (6), the difference between the perfective and the imperfective lies in the aktionsart-based enrichment of the meaning of the perfective variants. Whereas both imperfective forms are states, their perfective counterparts receive an inchoative interpretation. In the former case, there is no temporal limitation on the duration of the hearing or feeling event. In the latter case, however, the left boundary of these events is marked. Importantly, the child and the rain are not affected by being perceived.

Now we can take a look at incremental theme verbs that are the main topic of this paper. Consider the following examples, based on the initial observation of Wierzbicka (1967).

(7) Jan skonsumował gruszkę, #której resztki widzisz
Jan consumed.PFV pear of.which rests see.2SG
na stole / #ale część zostawił.
on table / but part left
‘Jan has consumed a pear the rests of which you see on the table/but he left a part of it.’
Implication: The process of eating is completed; the pear is not there anymore.

(8) Jan konsumował gruszkę, którego resztki widzisz
Jan consumed.IPFV pear of.which rests see.2SG
na stole / ale część zostawił.
on table / but part left
‘Jan was consuming a pear the rests of which you see on the table/but he left a part of it.’
Implication: The process of eating is not necessarily completed. The amount of pear decreases during the process of eating.
Examples (7) and (8) make clear that a direct object of incremental theme verbs is directly influenced by the verbal process. More precisely, it gradually changes its quantity in the course of this process. The perfective implies a total affectedness, which, in the case of the object of ‘consume’, translates to a complete disappearance of the object. In contrast, the imperfective ‘consume’ only implies a partial affectedness of the object, i.e. its partial disappearance.

The fact that partial affectedness of the object is indeed implied by imperfective incremental theme verbs can be confirmed by (9), a phenomenon known as veridicality of the progressive (cf. Giannakidou and Zwarts, 1999; Giannakidou, 2014).

(9) Jan konsumował gruszkę, #ale jest ona wciąż cała / Jan consumed.\textsc{pfv} pear but is it still intact / #ale nawet nie zaczął. 'Jan was consuming a pear that is still intact/but he did not even start.'

Implication: There is a 1:1-relationship between subevents of eating a pear and parts of the pear that underwent these subevents (the so-called homomorphism from (sub)objects to (sub)events and vice versa, cf. Krifka, 1989a, 1989b, 1989c, 1992).

As was mentioned above, the way a direct object is affected by an incremental theme verb depends on the lexical semantics of the latter. ‘An article’ in ‘read an article’ is an incremental theme, although the internal structure of the article does not change during the process of reading. However, the number of pages that were read corresponds to the realized subevents of reading (cf. Zuchewicz, 2020). More precisely, we can assume that there is an ideal of ‘read x’, where x is read till the end. In order to achieve this ideal (the so-called inherent culmination point of accomplishments), a group of temporally ordered subevents: \{e_1 < e_2 < e_3 < e_4\} gradually minimize the amount of pages that are left to be read. If x has 50 pages, we could have the following constellation: e_1 \rightarrow 40 pages left, e_2 \rightarrow 30 pages left, e_3 \rightarrow 15 pages left, e_4 \rightarrow 0 pages left. This shows that the completion of ‘read x’ is being achieved incrementally.

Importantly, an object is never incremental per se, compare (10).

(10) Jan namalował / #zjadł gruszkę, która leży na talerzu w dużym pokoju. Jan painted.\textsc{pfv} / ate.\textsc{pfv} pear which lies on table in big room 'Jan has painted/has eaten a pear that is lying on the plate in the living room.'

An interesting observation about (10) is that, despite the lack of the incremental relation between painting a pear that is lying on the table and this pear itself, there is an incremental relation between the painting event and the pear that is being painted. This relation is based on the gradual creation of an abstract object.

In the following, we will discuss Krifka’s formal implementation of the aspect-dependent (partial) completion of incremental theme verbs based on the homomorphism principle. We will further explain the advantage of an alternative analysis that defines partition only on the level of events, without dividing an object into parts.
2.2. Theoretical implementation by Krifka

Krifka (1989a: 92) formulated certain relations that define incrementality of a complex verbal predicate. Relations that must hold for all incremental theme verbs are mapping to objects (11) and mapping to events (12).

(11) \( \forall R[\text{MAP-O}(R) \leftrightarrow \forall e \forall e'[\text{R}(e,x) \land e' \subseteq E \rightarrow \exists x'[x' \subseteq O \land \text{R}(e',x')]]] \)

(12) \( \forall R[\text{MAP-E}(R) \leftrightarrow \forall e \forall x \forall x'\left[\text{R}(e,x) \land x' \subseteq O \rightarrow \exists e'[e' \subseteq E \land \text{R}(e',x')]] \]

According to mapping to objects (11), for every subevent, there is a respective subobject. For instance, every partial event of smoking a cigarette can be linked to the part of a cigarette that disappeared during that specific subevent. The reverse case holds for mapping to events (12). Here, parts of objects correspond to parts of events. Referring to the cigarette example, for every part of a cigarette that disappeared during a particular subevent of smoking, there exists such a subevent. Crucially, the presence of partial events requires the presence of partial objects that are mapped to these subevents, and the presence of partial objects implies that there are subevents that relate to these subobjects, and that have caused the affectedness of these subobjects (cf. Krifka, 1989a: 92). Importantly, the lack of partial objects implies the lack of partial events and vice versa.

Incremental theme verbs that combine with gradual effected ('house' in ‘build a house’) or gradual consumed patients ('cigarette’ in 'smoke a cigarette’) – the terminology is adapted from Krifka (1989a: 96) – are describable by an additional rule that is called uniqueness of events. Consider (13), cf. Krifka (1989a: 92).

(13) \( \forall R[\text{UNI-E}(R) \leftrightarrow \forall e \forall x \forall x'\left[\text{R}(e,x) \land x' \subseteq O \rightarrow \exists e'[e' \subseteq E \land \text{R}(e',x')]] \]

(13) applies to cases where an object is related to exactly one event. For instance, there can be only one event of smoking a particular cigarette, building a particular house etc. In contrast, the same book can be read multiple times, which is why uniqueness of events does not apply to incremental theme verbs that take gradual patients.

Clause-embedding incremental theme verbs that will be discussed in the next section belong to the ‘read a book’-group, which means that uniqueness of events does not relate to them either. In line with Zuchewicz (2020), we will refer to their arguments as gradual revealed patients.

The question arises as to how we can mark the lack of accessibility of subobjects and subevents in the case of the perfective aspect, where total affectedness of the object is implied. Building upon Krifka (1989b: 187), perfective incremental theme verbs can be represented by the combination of the explicit marking the incremental relation (INC) and the maximization restriction on the object (MAX), cf. (14) for ‘Jan built.PFV a chair.’ Since ‘chair’ appears in its totality, we cannot access its parts. As was mentioned above, the accessibility of parts of objects and events only functions as a 1:1 relationship.
As was mentioned above, Krifka’s account works for cases with a nominal incremental theme, where it is the object itself that has parts. In the next section, we will move on to incremental theme verbs with propositional complements. With the latter, an internal argument is realized by a that-clause. Crucially, as observed by Zuchewicz (2020), we cannot divide a proposition described by a that-clause into parts the way we divided nominal incremental themes. Therefore, following Zuchewicz (2020), we propose restricting incrementality to the level of events, which enables a unified analysis for different types of incremental relations. This will be done in the next sections.

3. Aspect and the interpretation of clausal complements of incremental theme verbs

3.1. An overview

Based on entailment patterns of (im)perfective clause-embedding verbs in Polish discussed in Zuchewicz (2018), Zuchewicz (2020) empirically investigated the relationship between aspect of three groups of such predicates and the truth-related meaning of the respective embedded propositions. The goal of the study was to verify whether and to what extent certain perfective clause-embedding predicates enforce their complements to be true. Furthermore, imperfective forms were used as primers, in order to investigate their relation to a possible lack or even blocking of truthfulness.

For the purpose of this paper, we will only discuss results for the so-called reveal-type predicates (‘prove (that)’, ‘reveal (that)’, ‘show (that)’), which exhibit an incremental structure and constitute a clausal counterpart to incremental theme verbs that combine with a nominal incremental theme.

In the next subsection, we will describe the truth inference of reveal-type predicates in more detail. Following this, we will present empirical evidence from the acceptability-judgement study (Zuchewicz, 2020).

3.2. Truth-entailment as a counterpart to total affectedness

Our object of investigation are pairs of sentences as presented in (15) and (16), adapted from Zuchewicz (2018, 2020).

\[\lambda e \exists x [\text{build}(e) \land x = \text{MAX} \text{(chair)} \land \text{INC}(e, x) \land \text{AG}(e, J)]\]

\[\text{(14)}\]

This term was proposed by Zuchewicz (2020).
The veridicality property of clause-embedding reveal-type predicates in Polish

(15) Jan udowodnił / dowiódł / wykazał /
      Jan proved.PFV / proved.PFV / revealed.PFV /
      pokazał, że Inga nie ma sześciu lat, #ale się
      showed.PFV that Inga NEG has six years but REFL
      pomylił / #ale okazało się to nieprawdą.
      was.wrong / but turned.out REFL it not.truth

‘Jan has proved/revealed/shown that Inga is not six years old, but he was wrong/but it turned out to be wrong.’
→ Inga is not six years old.

(16) Jan udowadniał / dowodził / wykazywał /
      Jan proved.IPFV / proved.IPFV / revealed.IPFV /
      pokazywał, że Inga nie ma sześciu lat, ale się
      showed.IPFV that Inga NEG has six years but REFL
      pomylił / ale okazało się to nieprawdą.
      was.wrong / but turned.out REFL it not.truth

‘Jan was proving/revealing/showing that Inga is not six years old, but he was wrong/but it turned out to be wrong.’
→ Inga is not six years old.

The above examples demonstrate that perfective incremental theme verbs (15), in contrast to their imperfective counterparts (16), imply that the proposition expressed by the that-clause is true; only (16) can be followed by ‘but he was wrong’ / ‘but it turned out to be wrong’. However, the inference presented in (15) does not survive under negation, in yes-/no-questions or after the addition of a modal adverbial, cf. (17), adapted from Zuchewicz (2018, 2020).

(17) Jan nie udowodnił / dowiódł / wykazał /
      Jan NEG proved.PFV / proved.PFV / revealed.PFV /
      pokazał, że Inga nie ma sześciu lat.
      showed.PFV that Inga NEG has six years

‘Jan has not proved/revealed/shown that Inga is not six years old.’
→ Inga is not six years old.

The fact that the truth-inference of the perfective is restricted to the affirmative environment, i.e. that it does not project and is therefore not presupposed (cf. Morgan, 1969; Langendoen and Savin, 1971; Chierchia and McConnell-Ginet, 2000 for the projection pattern), confirms that it is an implication (an entailment) and not a presupposition (cf. Kiparsky and Kiparsky, 1970; Karttunen, 1971 among others).

According to Egré (2008: 101), a verb that entails the truth of its complement in a positive declarative form, i.e. that fulfills the condition: ‘Vp → p for all p, where p is a that-clause’, is veridical (cf. also Giannakidou, 1994, 1998, 1999). We will adopt this terminology and call reveal-type predicates veridical verbs (in line with Zuchewicz, 2020).

The question arises as to how veridicality relates to total affectedness. Following Zuchewicz (2020), a veridical interpretation of perfective reveal-type predicates in Polish results from the presence of a proof for an embedded proposition. A proof consists of sequences of single pieces
of evidence. Thus, it exhibits a complex internal structure. If evidence available suffices to establish a proof, a that-sentence holds, i.e. a matrix verb receives a veridical meaning. Sufficient (maximal) evidence is only implied by the perfective aspect, and veridicality is a natural way of realizing completeness in the case of reveal-type predicates; something that has been proved/revealed/shown is usually taken for granted, unless there is an explicit indication that it should not. In other words, truthfulness is a natural component of the meaning of a proof which itself implies the presence of a sufficient amount of evidence.

The contrast between perfective and imperfective reveal-type predicates lies in implicating different amounts of evidence for the validity of a that-sentence. The imperfective implies that there is some (but not enough) evidence, i.e. that something has been done towards the establishment of the truth-value of an embedded proposition, and it implicates that there is no proof. On the event level, it works similarly to the realization of parts of events in the case of incremental theme verbs with nominal incremental themes (the presence of partial completions of eating bread/drinking water, with bread and water being affected by the corresponding processes), cf. (18), based on Zuchewicz (2020).

(18) Jan udowadniał / dowodził / wykazywał / pokazywał, że Inga nie ma sześciu lat, #ale nic nie zrobił w tym kierunku.
    Jan proved/IPFV / proved/IPFV / revealed/IPFV / showed/IPFV that Inga NEG has six years but nothing
    NEG did in this direction
    ‘Jan was proving/revealing/showing that Inga is not six years old, but he did nothing to prove it.’
    → Certain steps have been taken towards answering the question whether Inga is six years old or not.

According to Zuchewicz (2020), composing proof is incremental, and it can be compared to the creation of a new object. For instance, if we are planning to build a playhouse for our child, we can either buy all parts in a shop or do it from scratch by ourselves. Both ways can result in the existence of a playhouse. This shows that there are many possibilities of getting to x. Similarly, there can be different ways of proving p. For example, during an investigation, two commissioners may independently come to the same conclusion.

Zuchewicz (2020) points out that there is a crucial difference between building x and proving p however. While one cannot build the same house from different sets of parts/build the same house again and again, one can prove the same proposition by going multiple paths (by starting with different pieces of evidence, verifying different hypotheses etc.). With respect to this, proving p is more like reading x, where the same object can be affected by the verbal process unlimitedly.

The fact that the lack of proof in the case of the imperfective is an implication can be confirmed by the semantic well-formedness of sentences like: Jan udowadniał/dowodził/wykazywał/pokazywał, że Inga nie ma sześciu lat i miał rację. Ona ma dwanaście lat. ‘Jan was proving/revealing/showing that Inga is not six years old, and he was right. She is twelve years old.’ The same observation holds true for incremental theme verbs that take nominal complements: Jan jadł czekoladę i nie zostawił nam ani kawałka. ‘Jan was eating chocolate and he did not even leave a piece for us.’, cf. Padučeva (1996); Grønn (2003); Mueller-Reichau (2018) for different instances of the factual imperfective in Russian, and Danielewiczowa (2002); Zuchewicz (2020) for Polish.
To sum it up, we have shown that reveal-type predicates exhibit an incremental structure. The imperfective implies the presence of some pieces of evidence (some hints) for the validity of an embedded proposition, which are not strong enough to be transformed into a proof though. In contrast, the perfective implies the existence of maximal evidence, i.e. of a proof. In line with Zuchewicz (2020), the perfective builds upon the meaning of the imperfective by inserting a crucial piece of evidence to a proof chain. Importantly, composing a proof is incremental in nature: Even if a crucial piece of evidence appears immediately, we still have several steps in a proof chain that have led to its detection. The presence of a proof for the proposition expressed by the \textit{that}-clause explains a veridical meaning of perfective reveal-type predicates.\footnote{Building upon Zuchewicz (2020), it needs to be pointed out that the proof for a proposition as defined in this paper needs to be distinguished from a mathematical proof (Schroeder-Heister, 1991; Martin-Löf, 1998; Schroeder-Heister, 2006 among others). The truth of a proposition, in contrast to the mathematical truth, holds independently of the process of proving. More precisely, neither does the ‘truth’ depend on the subevents of proving, nor do single pieces of evidence (hints) depend on each other. For example, the answer to the question ‘Who ate two boxes of donuts?’ does not depend on the result of an investigation; there is a particular person who ate two boxes of donuts in the world of evaluation. Furthermore, evidence 1: Anna was playing with a friend outside \{so it was not her who ate two boxes of donuts\}, and evidence 2: Ela was at school \{so it was not her either\} are independent pieces of evidence that cause a progress of an investigation but are not necessary in order to find a culprit.}

In the next subsection, we will briefly discuss empirical evidence for veridicality of perfective clause-embedding reveal-type predicates in Polish, and for the lack of (inherent) veridicality in the case of the respective imperfective counterparts (Zuchewicz, 2020). The fact that Polish native speakers interpret perfective reveal-type predicates as veridical speaks for the integration of veridicality into the core lexical meaning of these verbs.

3.3. Empirical evidence for the relationship between perfectivity and veridicality in Polish

Zuchewicz (2020) conducted an acceptability judgment study with 51 Polish native speakers. 10 clause-embedding reveal-type predicates – 5 minimal pairs that differed only with respect to the aspect of the matrix verb – were presented jointly in a factive and a non-factive scenario. The experimental design included a Likert scale with joint presentation, cf. Marty et al. (2018).

Figure 1 shows an example of a test item for the aspectual pair \textit{udowodnić} – \textit{udowadniać} ‘prove’. Importantly, the participants were never presented with the members of an aspectual pair in the two scenarios one after another. Furthermore, (im)perfective alternatives of every verb pair were presented in reverse order in the (non-)factive environments (for example, for a verb pair X, first perfective, second imperfective in a factive context, and first imperfective, second perfective in a non-factive one).
Consider what follows a fact: Today it became clear that Alicja stole our company computer.

Commissioner Jankowski and commissioner Nowak independently of each other investigated the case. Only commissioner Nowak irrefutably documented that Alicja was to blame –

(a) (He) proved.PFV that she was guilty.  
very good OOOOOOO very bad
(b) (He) proved.IPV that she was guilty.  
very good OOOOOOO very bad

Consider what follows a fact: Today it became clear that Fryderyk stole our company computer.

During the investigation commissioner Malinowski picked out Józef, and commissioner Stępień Fryderyk. Commissioner Malinowski could hardly accept that he was wrong –

(a) (He) proved.PFV that Józef was guilty.  
very good OOOOOOO very bad
(b) (He) proved.IPV that Józef was guilty.  
very good OOOOOOO very bad

Figure 1: A factive and a non-factive scenario for the verb pair udowodnić – udowadniać (‘prove’), adapted from: Zuchewicz (2020: 137–138).

Joint presentation was used in order to ensure that differences in acceptability could only be traced back to aspect (for the importance of deciding on the right task, see Sprouse and Almeida, 2011, 2017 among others).

Participants were asked to mark the acceptability of both alternatives in the given scenarios on a 7-point scale between ‘perfect’ and ‘very bad’. In the factive scenario, it was expected that perfective forms are ranked higher than their imperfective counterparts. In the non-factive scenario, the reverse tendency was expected to occur. Crucially, while the imperfective was not expected to be completely rejected in the factive context, the perfective was expected to be rejected in the non-factive one. The names of the characters were unique for every verb pair in a particular scenario, which means that each name occurred in the experiment only once.

Figure 2 summarizes the results for reveal-type-predicates.

Figure 2: Acceptability of (im)perfective reveal-type predicates in Polish in a factive (F) and a non-factive scenario (NF). ‘1’ stands for the highest acceptance and ‘6’ for the lowest one.

Figure 2 clearly shows that (im)perfective forms of reveal-type predicates are complementary distributed across scenarios, which means that the results were even stronger than expected.
Whereas the perfective is only accepted if it embeds true states of affairs, the imperfective is almost only possible with that-sentences which do not hold true.\(^5\)

Zuchewicz (2020: 145) analyzed the results with the paired-samples t-test (cf. Gries, 2009 among others). It revealed, for the factive scenario, a significant difference between the perfective and the imperfective aspect ratings \((t = 24.983, df = 4, p < 0.001)\), with the imperfective scoring lower (i.e. being worse) than the perfective. In the non-factive scenario, the reverse difference occurred, also significant \((t = -6.0464, df = 4, p < 0.01)\), with the perfective scoring lower than the imperfective.

As was mentioned above, these results confirm that there is a correlation between verbal aspect with incremental theme verbs and the veridical interpretation of these verbs.\(^6\)

4. A unified analysis of incremental theme verbs regardless of their argument type: Formalization with the REAL-operator

In this section, we will present a unified analysis of incremental theme verbs that combine with either nominal or propositional complements, based on Zuchewicz (2020). In line with Zuchewicz (2020), we will follow Neo-Davidsonian event semantics (Castañeda, 1967; Carlson, 1984; Parsons, 1990; Krifka, 1992; Landman, 2000; Champollion, 2016 among others), and introduce variables for events only. The representation of nominal and propositional complements is ensured by establishing an incremental relation between a verbal event and an object (in the following the so-called \(\text{INC}\)-relation, where \(\text{INC}\) stands for ‘incrementality’). The advantage of choosing Neo-Davidsonian event semantics lies in the fact that, in this approach, all arguments are represented as relations to events (i.e. the type of object does not matter for its representation; there is no differentiation between arguments and adjuncts), which is why the integration of a clausal complement into the analysis does not make it necessary to significantly modify and additionally justify the formulas.

We will begin with the analysis of incremental theme verbs that take a nominal incremental theme.

\(^5\) Following lexemes were investigated: \textit{udowodnić}.pfv – \textit{udowadniać}.ipfv ‘prove’, \textit{dowieść}.pfv – \textit{dowodzić}.ipfv ‘prove’, \textit{wykazać}.pfv – \textit{wykazywać}.ipfv ‘reveal’, \textit{pokazać}.pfv – \textit{pokazywać}.ipfv ‘show’ and \textit{potwierdzić}.pfv – \textit{potwierdzać}.ipfv ‘confirm’. Zuchewicz (2020) included ‘confirm’ to the data set for explorative reasons. An interesting result is that, in contrast to other perfective verbs listed above, \textit{potwierdzić} was not completely ruled out in the non-factive scenario; it received a middle acceptance rate, cf. Figure 2. This means that it lacks inherent veridicality. Consider also the following contrast: \textit{Krzysiek #proved/confirmed that Iga was guilty, although she was not guilty, and he knew about that} [about the fact that Iga was not guilty] (adapted from: Zuchewicz, 2020: 155). Furthermore, it can be shown that ‘confirm’ does not exhibit an incremental structure: \textit{Krzysiek just #proved/confirmed that Iga became a new boss, without having dealt with the case at all} (adapted from: Zuchewicz, 2020: 155). These observations provide an extra argument for the relationship between incrementality and veridicality. In line with Zuchewicz (2020), we do not treat ‘confirm’ as a reveal-type predicate.

\(^6\) The correlation between perfectivity and veridicality (or rather between perfectivity and different types of truth-inferences) is not restricted to Polish. Zuchewicz (2020) provided further evidence from Czech, Russian, Hungarian and two Austronesian languages Daakaka and Mavea. Bhatt (1999) described such a relationship for perfective ability modals and their complements in Greek and Hindi, and Hacquard (2006) followed with similar examples from French. For more details on the cross-linguistic evidence see Zuchewicz (2018, 2020).
4.1. Incremental theme verbs with nominal complements

As was mentioned above, incremental theme verbs that take nominal complements enforce the affectedness of the object by the verbal process and a 1:1 correlation between (sub)objects and (sub)events. However, the affectedness can but does not have to imply changing the internal structure of the object. For instance, an essay that has been read remains the same before, during and after the process of reading; its pages are gradually integrated into every subevent of reading, though. In contrast, a pear disappears completely after it has been eaten. Thus, a crucial criterion for incrementality is an incremental/gradual relation between a verb and its argument.

Following Zuchewicz (2020), we are making use of the REAL-operator that scopes over (partial) events that are realized in the world of evaluation. The realization can be specified as eating, drinking, reading, proving etc., so it is not bound to any particular sort of affectedness. Although REAL explicitly relates to (partial) events, the events themselves contain (partial) objects as their essential components; an incremental event cannot be instantiated without its incremental theme. More precisely, the realization of partial events implies the realization/affectedness of partial objects, and the realization of an entire event implies the affectedness of an entire object (due to the 1:1 relationship between (sub)objects and (sub)events). After the endpoint of an entire event has been reached, the accessibility of parts of an object is blocked.

We can start with the perfective zbudować szafkę ‘build.PFV cabinet’, cf. (19). Based on Zuchewicz (2020), the perfective implies that a complete event e has been realized in the world of evaluation w₀, i.e. that a cabinet has been created.

Building upon Zuchewicz (2020: 179), (19) can be read as follows: e is an entirely realized building event in w₀ that is in an incremental relation to a cabinet in w₀. A complete realization of an entire event implies a complete affectedness of an object, since the object is incrementally bound to the entire event.

\[(19) \text{ in } w₀: \lambda e[\text{build}(w₀)(e) \land \text{REAL}(w₀)(e) \land \text{INC}(w₀)(e, \text{cabinet})] \]

with existential closure:
\[\exists e[\text{build}(w₀)(e) \land \text{REAL}(w₀)(e) \land \text{INC}(w₀)(e, \text{cabinet})] \]
Adapted from: Zuchewicz (2020: 180)

(20) illustrates single steps in the derivation that have led to (19). Based on Zuchewicz (2020: 180), we follow standard assumptions on aspectual composition, where the aspect combines with a VP in order to form the aspect phrase. Step 3 introduces the meaning of the perfective; the perfective requires the realization of the entire event e in the world of evaluation w₀.
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In contrast, the imperfective budować szafkę ‘build.IPFV cabinet’ (21) implies the realization of partial events e′ in w0. We can read (21) as follows: e is an ideal of a building event in w0 (i.e. a building event that reaches its natural endpoint, giving rise to the creation of a new object) that has not been realized in w0, and e′ is a part of e in w0 that has been realized in w0. There is an incremental relation between the ideal (complete) event e and a cabinet in w0. The instantiation of a partial event implies the creation of some parts of a cabinet; since there is an incremental relation between the object and an ideal event, and since parts of this event are realized in w0, there exist corresponding parts of the cabinet that are effects of the finished subphases of the building process. Importantly, the whole event e does not necessarily exist totally in the real world, as REAL only applies to the partial event e′ (cf. Zuchewicz 2020: 180).

\[ \lambda e'[\lambda e[\text{build}(w_0)(e) \land e \sqsubseteq e \land \text{REAL}(w_0)(e') \land \text{INC}(w_0)(e, \text{cabinet})] \]

with existential closure:

\[ \exists e \exists e'[\lambda e[\text{build}(w_0)(e) \land e \sqsubseteq e \land \text{REAL}(w_0)(e') \land \text{INC}(w_0)(e, \text{cabinet})] \]

Adapted from: Zuchewicz (2020: 181)

Compared to the perfective, the only difference in the derivation is the modification of the meaning of an aspectual operator, here AspIPfv. As was mentioned above, the imperfective requires the realization of partial event(s) e′ in the world of evaluation w0, as step 3 illustrates.

In the next subsection, we will present semantic representations of (im)perfective incremental theme verbs that combine with propositional complements.

4.2. Incremental theme verbs with propositional complements

According to Zuchewicz (2020), clause-embedding reveal-type predicates like ‘prove’, ‘reveal’ or ‘show’ are incremental, because they imply a gradual creation of proof. Proof has a complex structure that includes single pieces of evidence (hints or steps) that have been taken towards the identification of a crucial piece of evidence. A gradual process of the creation of a proof is similar to the creation of a nominal object. However, the incremental character per se
resembles more that of predicates like ‘read a book’. This is because the validity of a particular proposition can be verified many times, during different events.

We will start with the formal representation of perfective clause-embedding reveal-type predicates, cf. (23) for pokazać, że ‘show.PFV that’.

As was said above, perfective reveal-type predicates imply that there is a proof for the proposition expressed by the that-clause, which is why this proposition is interpreted as true. Building upon Zuchewicz (2020: 182), (23) receives the following interpretation: e is an event of showing (something) that is entirely realized in w₀, and there is an incremental relation between this event and a propositional object p in w₀. A complete realization of an entire event in the world of evaluation implies the revelation of the truth-conditional object: An embedded proposition holds true, i.e. there is a proof for it.

The only difference between the semantic representation of incremental theme verbs with nominal and propositional complements lies in the specification of the category of a direct object argument.

(23) in w₀:
\[ \lambda e[\text{show}(w_0)(e) \land \text{REAL}(w_0)(e) \land \text{INC}(w_0)(e,p^7)] \]

with existential closure:
\[ \exists e[\text{show}(w_0)(e) \land \text{REAL}(w_0)(e) \land \text{INC}(w_0)(e,p)]^8 \]
Adapted from: Zuchewicz (2020: 182)

Single steps in the derivation are the same as in the case of incremental theme verbs with nominal arguments.

(24) V
1. = \lambda P \lambda e[P(e)](\text{show})
VP
2. = \lambda e[\text{show}(e) \land \text{INC}(e,p)]
Asp_{PFV}
3. = \lambda P \lambda e[P(w_0)(e) \land \text{REAL}(w_0)(e)]
4. = \lambda P \lambda e[P(w_0)(e) \land \text{REAL}(w_0)(e)[\lambda e[\text{show}(e) \land \text{INC}(e,p)]]]
AspP
5. = \lambda e[\text{show}(w_0)(e) \land \text{REAL}(w_0)(e) \land \text{INC}(w_0)(e,p)]
Adapted from: Zuchewicz (2020: 182)

Now we can move on to the semantic representation of the imperfective counterparts. In line with Zuchewicz (2020), imperfective reveal-type predicates imply the realization of some subevents of entirely non-complete processes of proving/revealing/showing. Since the processes themselves are still ongoing, the evidence available does not suffice to establish a proof for an embedded proposition.

(25) introduces the semantic representation of pokazywać, że ‘show.IPVF that’: e is an ideal of an event of showing (something) in w₀ that has not been instantiated in w₀. This ideal represents a situation where something has been proven true (revealed, shown etc.). The ideal e has a

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8 The existence of a complete event in a world of evaluation means the revelation of the truth-conditional object, cf. Zuchewicz (2020).
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partial event e' in w_0 that has been realized in w_0. There is an incremental relation between e and a propositional object p. Due to the fact that an incremental relation holds between p and an ideal/non-realized event e, there is no proof for p yet. The instantiation of (some) subevents of showing e' implies the presence of single pieces of evidence (hints) that suggest that p. According to Zuchewicz (2020: 183), imperfective reveal-type predicates can be characterized by the 1:1 mapping between subevents of proving/revealing/showing and single pieces of evidence that occurred during these subevents/that caused a progress in the investigation.

(25) in w_0:
\[ \lambda e' \lambda e[\text{show}(w_0)(e) \land e' \sqsubseteq e \land \text{REAL}(w_0)(e') \land \text{INC}(w_0)(e,p)] \]

with existential closure:
\[ \exists e \exists e'[\text{show}(w_0)(e) \land e' \sqsubseteq e \land \text{REAL}(w_0)(e') \land \text{INC}(w_0)(e,p)] \]
Adapted from: Zuchewicz (2020: 183)

As example (26) illustrates, the only difference in the derivation compared to imperfective incremental theme verbs with nominal complements is the presence of a clausal (and not a nominal) patient.

(26) \begin{align*}
V & \quad 1. = \lambda P \lambda e[P(e)](\text{show}) \\
VP & \quad 2. = \lambda e[\text{show}(e) \land \text{INC}(e,p)] \\
Asp_{\text{ipfv}} & \quad 3. = \lambda P \lambda e \lambda e'[P(e) \land e' \sqsubseteq e \land \text{REAL}(w_0)(e')]
\quad 4. = \lambda P \lambda e \lambda e'[P(w_0)(e) \land e' \sqsubseteq e \land \text{REAL}(w_0)(e')](\lambda e[\text{show}(e) \land \text{INC}(e,p)])
\quad 5. = \lambda e' \lambda e[\text{show}(w_0)(e) \land e' \sqsubseteq e \land \text{REAL}(w_0)(e') \land \text{INC}(w_0)(e,p)]
\end{align*}
Adapted from: Zuchewicz (2020: 183)

5. Summary

In this article, we proposed an account of generalized incrementality for Polish, building upon Zuchewicz (2020). We have shown that establishing an incremental relation between an event and an object as well as operating on realized/instantiated (parts of) events makes it possible to capture incrementality of predicates regardless of the type of the complement they combine with. We have further shown that incrementality of clause-embedding reveal-type predicates like ‘prove that’, ‘reveal that’ or ‘show that’ is based on composing proof. In line with Zuchewicz (2020), we assume that proof has a complex internal structure; it consists of single pieces of evidence and all other steps that are necessary in order for the investigation to go on. With the perfective, the amount of single pieces of evidence is enough in order to interpret a that-clause as true. In this case, evidence turns into a proof. This explains why perfective clause-embedding reveal-type predicates are systematically veridical. In contrast, imperfective reveal-type predicates imply that something has been done towards establishing a truth-value of an embedded proposition, i.e. that there are some pieces of evidence for p, and they implicate that there is no proof, i.e. that evidence is not sufficient in order to be transformed into a proof. As a result, it is left open whether a that-clause holds or not. Following Zuchewicz (2020), we have shown that composing proof does not differ much from building a cabinet or reading an essay. Therefore, we proposed a unified analysis for incremental theme verbs that combine with nouns and clauses.
One of the editors suggested an interesting and important follow-up research on the impact of tense on the veridical interpretation of perfective verbs. Zuchewicz (2018: 482) explains why using the past tense in the (im)perfective matrix verbs in Polish is most suitable for the investigation itself. Since the past tense morphology is available for all stems regardless of their aspectual marking, and since it always results in the reference to the past, it enables the creation of minimal pairs that only differ in the delimitation of events described by matrix verbs. A detailed study on the influence of tense on veridicality will be the subject of future research. We plan to investigate languages with and without a grammatical category of aspect. It cannot be excluded that, depending on the morphological system, some languages allow minimal pairs not only in the past tense/in other tenses. This would be helpful for creating items for empirical studies.

References


Contiguity and membership and the typology of collective nouns

Joost ZWARTS — Utrecht University

Abstract. In the semantics of human collective nouns there are two mechanisms at work, leading to distinct types of collectivity. The collectivity of ‘crowds’ is based on the contiguity of its elements, while the contiguity of ‘clubs’ is based on membership in a social institution. This proposal strengthens and unifies earlier proposals about the nature and typology of collective nouns; it accounts for a range of new and old observations about the variety of collective nouns and it connects to recent insights in the study of collective reference more generally.

Keywords: collectivity, contiguity, membership.

1. Introduction

A collective noun like club or crowd refers to a set of people as a whole, as intuitively represented in the picture in the middle of Figure 1. One of the central questions in the study of such nouns concerns the basis of their collectivity: what makes a set of people a whole of some sort, so that we can refer to it with a singular noun (see de Vries, 2019 for a recent review)? This paper contributes to this question by identifying two subtypes of (human) collections that are, in a sense, formed in opposite ways: what I call ‘crowds’ and ‘clubs’, with their corresponding nouns.

(1) ‘crowd’ nouns: circle, crowd, horde, mass, procession, queue, throng
‘club’ nouns: cabinet, choir, church, club, collective, committee, company, corps

The collectivity of ‘crowds’ (corresponding to the → arrow in Figure 1) starts with a set of individuals that are spatially contiguous and close enough to form a whole ‘around’ them. The collectivity of ‘clubs’ (corresponding to the ← arrow in Figure 1) starts with a whole that can have members ‘in’ it.

Figure 1: Two ways of forming collections

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Collective nouns of both types show the same duality of ‘one’ (the whole) versus ‘more’ (the parts), but they differ in how this configuration is derived.

This proposal strengthens and unifies earlier proposals about the nature and typology of collective nouns (Anderson, 2018; Dočekal & Wągiel, 2018; Henderson, 2017; Joosten, 2010; Pearson, 2011); it accounts for a range of new and old observations about the variety of collective nouns, and it connects to recent insights in the study of collective reference more generally (Kruitwagen et al., 2017). By restricting its scope to human collective nouns, this typology neutralizes the confounding effect of animacy (de Vries, 2015) allowing us to see that both types of collectives actually show plural behaviour (pace Henderson, 2017; Pearson, 2011).

The paper starts by showing that Joosten’s (2010) notion of contiguity works for crowds, but not for clubs (section 1). Instead, clubs are based on a social notion of membership (section 2). After a sketch of how this distinction is formalized (section 3), I discuss a range of empirical consequences of this distinction (based on Dutch, section 4). Section 5 shows that the club/crowd distinction is independent of the singular/plural behaviour of collectives, which is a function of the animacy of its elements. Section 6 wraps up the paper.

2. The contiguity of crowds

What makes a set of individuals a collection? Joosten (2010, p. 38) makes a suggestion that is based on contiguity (see also Joosten and Vermeire, 2006):

the individual entities are related to each other by contiguity, by an external bond. The specific nature of that external relation can be of different sorts — spatio-temporal (archipel, troupeau), social (couple, tribu), cooperative (club, armée), or functional (couvert, paire (de chaussures)) — but in any case the basis on which the individual entities are grouped, is contiguity.

The idea of Joosten is that the elements of a collection are close together (contiguous) because of how they are related to each other in a particular way. He illustrates this by lines connecting the elements in the central picture of Figure 1, representing this “external relation”. Intuitively, it is because of these connections that a collection hangs together, in his view. Joosten and Vermeire (2006) characterize social, cooperative, and functional contiguity as “strong” and spatio-temporal contiguity as “weak”, because of the more permanent status of the first three across time and space.

However, we need to take a critical look at how an “external relation” actually contributes to collectivity. It turns out that spatio-temporal contiguity works well as a collectivizing factor for a subset of the collective nouns (what I call ‘crowds’), but that the other types of contiguity do not lead to collectivity in the way that Joosten would want it (for what I call ‘clubs’).

Consider again nouns like circle, crowd, horde, mass, procession, queue, and throng. If there is a sufficient number of people that are close enough to each other to form a spatial pattern, then that can be a basis for grouping them into a whole and for calling that whole a crowd or
a queue, for instance. The “external bond” is a particular spatial relation holding between elements, like closeness or adjacency, that creates the higher-order collection with its own spatial properties (like size, shape, and orientation).

More generally, contiguity holds for the wider type of collectivity that Henderson (2017, p. 161) calls “swarm reference, [which] picks out higher-order collective entities defined in terms of the spatial and temporal configuration of their constituent individuals.” In this class we find the rich variety of animal collectives (like herd, flock, shoal, etc.). Joosten’s notion of spatial contiguity also corresponds to Grimm’s (2012) spatial connectedness in his “mereotopology” of collective aggregates, which are types of entities (like insects, for instance) that tend to occur clustered together and to be named by mass nouns or non-derived plurals across languages. Mador-Haim & Winter (2015, p. 467) and De Vries (2015, pp. 22–23, 129) argue that the possibility of a plural definite like the ticket inspectors to have atomic reference (like the row of ticket inspectors) also depends on the individuals being ‘lined up’. In other words, there is an emerging type of collectivity in the literature that relies on spatial contiguity in a crucial way.

Contiguity also corresponds in an interesting way to the notion of convexity in the conceptual space sense of Gärdenfors (2000). Crowd type collections are convex with respect to an appropriate notion of ‘betweenness’ holding over an underlying space. This is illustrated by the entailment pattern in (2a), that shows that a crowd type collection is closed under betweenness. Note that what counts as ‘between’ is sensitive to the shape of the collection, as amply discussed for German zwischen in Habel (1989).

(2) a. A and B are part of the crowd/circle/queue.
   C is between A and B.
   \[\Rightarrow\] C is part of the crowd/circle/queue.

b. A and B are part of generation X.
   C’s birthday is between A’s and B’s birthdays.
   \[\Rightarrow\] C is part of generation X.

(2b) gives a temporal example of convexity, featuring the temporal collective noun generation. The boundaries of a generation may be notoriously vague, but the convexity demonstrated in (2b) is a clear matter. Beyond space and time, collective nouns like class or stratum might be convex with respect to an underlying economic scale (of income, for instance).

However, it is not clear how we could apply this kind of contiguity to all collectives, as Joosten suggests. Specifically, contiguity does not work for the kind of human collections that I have labeled as clubs, like cabinets, clubs, and committees. Joosten suggests that clubs and armies are based on cooperation, but that can be shown to be incorrect. To start with, cooperation is not a sufficient condition for constituting a committee or army, as the invalid entailments in (3) show.

(3) a. A and B are part of committee X.
   C is cooperating with both A and B.
   \[\not\Rightarrow\] C is a part of committee X.
b. A collaborates with the army of the enemy.
\[\Rightarrow\] A is part of the army of the enemy.

In order to make sense of contiguity in these situations (in analogy with the spatio-temporal case), we would have to say for (3a) that C is ‘between’ two members A and B of a committee if C is cooperating with both (or maybe even mediating between them). However, this does not make C a part of the committee. Similarly, in (3b), collaboration with the army of the enemy does not make somebody part of the army of the enemy.

Furthermore, cooperation is neither a necessary condition for being part of a committee or army. The examples in (4) are not contradictions, as one would expect when collaborative connections are constitutive for committees and armies.

(4) a. A is part of the committee, but not cooperating with other people in the committee.

b. A is part of the army, but only collaborating with the enemy.

So, contiguity only makes sense for a relatively small class of collections, with a small number of underlying domains (at least space and time), but it does not work for the much larger class of collections that involve social, collaborative or functional relations. The question is then what other basis there could be for forming collections. This is where membership comes in.

2. The membership of clubs

There is a general notion of membership, used in mathematics (a set with its members) and metalinguistically, for instance, in the semantics of groups (collections) of Barker (1992); where each group is mapped to a set of its members in virtue of a general membership function. However, the actual linguistic use of the corresponding word in natural language turns out to be much more restricted. This is illustrated with data from Dutch, featuring the word *lid* ‘member’ (5).²

(5) a. Anna is een lid van de club / het comité / de kerk.
   ‘Anna is a member of the club / committee / church.’

b. ?Anna is een lid van de kring / menigte / rij.
   ‘Anna is a member of the circle / crowd / queue.’

While one can say that Anna is a member of a club, committee or church in Dutch (5a), this is not possible for any of the crowd nouns (5b). The first argument of the relation denoted by

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² I do not know whether counterparts of *lid* in other languages (English *member*, German *Glied*) show the same restricted behaviour, but even if they are more general now, they must have had a more restricted application. The basis for this assumption is the fact that ‘member’ words in different European languages (Latin *membrum*, Greek *melos*, German *Glied*) started with a physical ‘limb’ meaning. They developed a social member meaning because the human body was used as the metaphorical source domain for social structures (like society, church, family) with limbs of the body standing figuratively for human parts of the social structure.
lid must be a human being and the second argument of the relation can only be a collection of a particular, social type.  

A similar observation has been made by Joosten and Vermeire (2006) on the basis of compounds headed by lid. They found compounds like clublid ‘club member’ and comitélid ‘committee member’, but no compounds like menigtelid ‘crowd member’ or rijlid ‘queue member’. (Kerk ‘church’ was not in their data set as a collection. The noun kringlid ‘circle member’ does exist, but only with the social ‘group’ meaning of kring, not the spatial ‘circle’ meaning.)

This restriction suggests that the kind of membership that is associated with the word lid is not a ‘brute fact’ (like being part of a crowd) or an abstract mathematical notion (like being an element of a set), but an ‘institutional fact’, a socially recognized ‘status’ that a person shares with other persons (Searle, 1995). This status does not have to be official or formalized; groups without a formal status can also have members, as long as their existence and membership is socially recognized. Membership typically involves activities for a member, but the activities do not themselves establish membership. As we already saw, one can be a member of a committee without showing any activity that would be required for that membership.

This brings us to the following generalization. Within the class of human collective nouns, we can distinguish two subclasses, crowd nouns and club nouns. Crowd nouns show contiguity but have no membership; clubs have members, but no contiguity.

There are collective nouns that cannot be straightforwardly classified as either crowd noun or club noun, given the criteria. The noun echtpaar ‘couple’ clearly seems to refer to a (very small) social group, but it does not occur with lid (6a). It seems then that the use of lid is restricted by factors that are independent of the crowd/club distinction, although the nature and strength of these factors is unclear. To me it sounds strange to talk about a member of the army (6b), but actually, examples of this phrase can easily be found on the web. It is conceivable that a salient word like soldaat ‘soldier’ blocks the periphrastic member construction in most contexts.

(6) a. *een lid van het echtpaar
   a member of the couple
b. ?een lid van het leger
   a member of the army

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3 With the exception of biological classifications (e.g. het enige lid van de onderfamilie Rousseoidea ‘the only member of the subfamily Rousseoidea’), which are based on a conceptual metaphor that maps on a source domain of human collections (like families).

4 Such restrictions are also found in other languages (Yoad Winter, personal communication). The Hebrew word xaver (‘member, friend’) is not used for mishpaza ‘family’, but the word ben ‘son’ is preferred instead. However, with other collectives (like zug ‘couple’), this noun or its female counterpart bat ‘daughter’ does not express membership: ben/bat-zug does not mean ‘member of couple’ but ‘husband’/’wife’, respectively. Clearly, across languages, there are lexical idiosyncrasies that disturb the general behaviour of membership nouns.
We also need to recognize the existence of club nouns of which the membership might partially interact with ‘brute facts’. The membership of a family, for instance, is not just a purely social affair, but it also typically involves natural, consanguinal relations (in addition to relations that are based on marriage (affinal kinship) and adoption (fictive kinship)). Still, we can talk about members of a family in a general way, ignoring the types of kinship. Collectives like *people* or *population* also have complex constitutive factors, combining ‘brute’ contiguity (e.g., their territory) with ‘social’ membership.

Sometimes, membership and contiguity may go together in typical ways. A typical choir has a form of institutional membership, but its members will also come together and sing the same song simultaneously. Only atypical choirs have members scattered over the globe that have never sung together or that work like a ‘flash mob’. In this case, we can see the two collective factors of contiguity and membership as conceptual preferences in the concept of a choir, potentially converging with the recent findings about collective verbs in Kruitwagen et al. (2017). These authors demonstrate that the typicality of an event $e$ in the category of a collective *hug* of two people $A$ and $B$ depends on the factor of *participation* of $A$ and $B$ (a more physical, spatial matter) and the factor of *collective intentionality* of $A$ and $B$ (a more psychological, social matter).

3. Membranes and members

In the formal semantic literature, collections have been treated as *atoms* (Barker, 1992) or, alternatively, as *sets* of individuals (see de Vries, in press for a recent overview), with appropriate shifts between these two types of denotations. It is not the objective of this paper to work out a semantics of collectivity along one of these two lines. Therefore, I have chosen to represent collections here in a way that gives priority to making the proposal explicit, without making the ontology too heavy. The question of how an atom-based or set-based approach can best accommodate contiguity and membership needs to be postponed to another occasion.

Collections are represented here as pairs $\langle X, c \rangle$ of a set of entities $X$ and an atom $c$, corresponding to the parts and the whole that are graphically represented in the middle of Figure 1. A collection is an atomic entity $c$ (type $e$) that is associated to a set of elements $X$ (type $et$), more or less like in Barker (1992). The two components of a collection can be related to each other by two opposite mappings (7) that I will call *membrane* and *members*.

$$
\begin{align*}
\text{(7) } & \text{ membrane}_{e|e} \text{ maps a set of individuals to its whole (for ‘crowds’)} \\
& \text{members}_{c|et} \text{ maps a whole to its set of members (for ‘clubs’)}
\end{align*}
$$

The *membrane* mapping is a partial function, only defined for a set $X$ of individuals that at a world-time index $i$ is in a contiguous spatial configuration. In that case the individuals together cover a spatial region (its ‘eigenspace’ or ‘spatial trace’) that is systematically related to the regions that are occupied by the individuals, as worked out in Henderson (2017) for ‘swarm’ reference and discussed briefly in Mador-Haim & Winter (2015) for collectives like *mountain range* or *row of utility poles*. This *membrane* function is part of what constitutes crowds.
The *members* mapping is also a partial function because it is only defined for certain regions (the social ones). If it is defined for an atom $c$, then it yields for each world-time index $i$ a (possibly empty) set $X$ of members of $c$. It is because of the dependence of the *members* function on world-time indices that an atom $c$ for which *members* is defined leads to an individual concept (Pearson, 2011). A noun phrase like *the committee* can correspond to a function from indices to sets because the underlying atomic collection has different members at different indices. This *members* function is relevant for club type collections.

Even though *membrane* and *members* are opposite mappings, they are not each other’s inverses, i.e., it is not the case that *membrane*(*members*(c)) = c and *members*(*membrane*(X)) = X. If $c$ is a choir, then *membrane*(*members*(c)) does not return the same club collection that it started with, but the crowd collection that corresponds to its members (if they choir members satisfy the spatial conditions for a crowd). And *members*(*membrane*(X)) is not a possible composition of functions because the crowd collection yielded by *membrane*(X) cannot be an argument of the *members* function (that requires a club collection as its argument).

The denotations of collective nouns like *queue* and *committee* are modeled here as sets of ordered pairs, as defined in (8). The idea is that a queue starts with a group of people $X$ that form a collective entity $c$ that has the shape of a queue (8a) and that a committee starts with a collective entity $c$ that has a set of members $X$ (8b).

\[
\begin{align*}
\text{(8)} \quad & \begin{align*}
\text{a. } & \left\{ \langle X, c \rangle : \text{people}(X) \land \text{queue}(c) \land \text{membrane}(X) = c \right\} \\
\text{b. } & \left\{ \langle X, c \rangle : \text{committee}(c) \land \text{members}(c) = X \right\}
\end{align*}
\end{align*}
\]

The core of both definitions is a condition on a collective whole $c$. The predicate *queue* defines the spatial properties of a queue (thin, linear shape, horizontal orientation). The predicate *committee* picks out collective wholes with a particular role in a larger social structure. In both definitions, the collective whole is related to a set of people, leading to the same type of denotation but in opposite directions. In (8a), there is a separate specification that the elements of $X$ are people (to distinguish it from crowd type collections that consist of animals). This restriction is already implied by the *members* function in (8b). The $i$ in (8) is the world-time index, making the $X,r$ pairs dependent on the index-dependent functions *membrane* and *members* (and possibly other index-dependent properties in the definition).

### 4. Differences (in Dutch) between clubs and crowds

Against the background of the characterization of clubs and crowds laid out in the previous sections, I will now discuss two sets of empirical differences between these two types of collections. The data are from Dutch (but the crowd/club is not restricted to Dutch, of course, and I assume that such empirical differences can be found in other languages too). Some of the differences have been noted in earlier work, some of the observations are new. The first set of differences is related to crowds being spatial in a literal, physical way while clubs can

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5 This does not exhaust the conceptual content of *queue*. The persons in a queue will also have a particular orientation with respect to the queue as a whole (looking forward) and the queue itself will typically be oriented with respect to a desk or an entrance. This might also be related to the intentions that a person has with being in the queue, a property that might be true for crowds more generally.
only be spatial in a figurative, functional way. The second set of differences has to do with the more independent existence of clubs with respect to their parts than crowds have (see also Joosten and Vermeire, 2006). Finally, I will also show how the club/crowd ambiguity of certain collective nouns supports the distinction between these types.

4.1. Spatial and non-spatial collections

The verb zitten ‘to sit’ in Dutch has a posture sense (like its English counterpart) in combination with locative PPs (9a), but (unlike its English counterpart) it loses the posture implication with PPs that do not refer to a literal location but to participation in an institution (9b).

(9) a. Ada zit op het grasveld / in de fauteuil.
Ada sit on the lawn / in the armchair
‘Ada is sitting on the lawn / in the armchair.’ (posture)

b. Bob zit op school / in de gevangenis.
Bob sit on school / in the prison
‘Bob is in school / in prison.’ (no posture)

With crowd nouns zitten entails a literal sitting posture (10a), but with club nouns there is no entailment of such a posture (10b).

(10) a. Anna zit in een menigte / rij.
Anna sit in a crowd / queue
‘Anna is part of a crowd / queue and sitting.’ (posture)

b. Anna zit in een comité / koor.
Anna sit in a committee / choir
‘Anna is part of a committee / choir.’ (no posture)

This supports the way crowds and clubs have been characterized: crowds are spatial (hence the spatial use of the preposition in and the verb zitten), but clubs are not (hence their figurative use).

We see something similar with verb-preposition combinations like stappen uit that has a literal meaning (‘take a step out of (something)’) with crowd nouns and a figurative meaning (‘step down from (something)’) with club nouns.

(11) a. Anna stapte uit de menigte.
Anna stepped out the crowd
‘Anna stepped out of the crowd.’ (literal stepping)

b. Anna stapte uit het comité.
Anna step out the committee
‘Anna stepped down from the committee.’ (figurative stepping)

The preposition binnen ‘within, inside’ requires an object with a physical boundary. It can not be used with a crowd noun: even though a crowd has a spatial extension, it does not have
a boundary. However, interestingly, binnen is possible with club nouns: not because the corresponding collections have physical boundaries, but because binnen shifts to a figurative meaning. This again supports the proposal that crowds occupy spatial regions and clubs are only spatial in a figurative sense.

(12) a. ?Er is een conflict binnen de menigte. (literal, but no boundary)
   ‘There is a conflict within the crowd.’
   b. Er is een conflict binnen het comité. (figurative boundary)
   ‘There is a conflict within the committee.’

The preposition in can be modified with the noun midden ‘middle’ making its spatial location more precise. The PPs in (13) show that this is possible with crowd nouns (13a), because they support a spatial region, but not with club nouns (13b).6

(13) a. midden in een menigte (spatial modification of P)
   ‘in the middle of a crowd’
   b. ?midden in een comité (no spatial modification of P)
   ‘in the middle of a committee’

As Henderson (2017) already pointed out for swarm nouns, the crowd nouns themselves allow modification with spatial adjectives (14a), but not the club nouns (14b). (But crucially, breed ‘wide’ can get a figurative meaning in (14a), referring to the varied membership of the committee.)

(14) a. een dichte/brede menigte (spatial modification of N)
   ‘a dense/wide crowd’
   b. ?een dicht/breed comité (no spatial modification of N)
   ‘a dense/wide committee’

Finally, the spatial preposition tussen ‘among’ leads to different entailments for crowds and clubs. Standing among a crowd (15a) necessarily implies being part of that crowd (15a’), but standing among a cabinet (15b) does not imply being part of that cabinet (15b’).

(15) a. Anna staat tussen de menigte.
   Anna is standing among the crowd
   ‘Anna is standing among the crowd.’
   a’. ⇒ Anna is deel van de menigte.
   ‘Anna is part of the crowd.’ (spatial inclusion)
   b. Anna staat tussen het kabinet.
   Anna is standing between the cabinet
   ‘Anna is standing among the cabinet.’

6 Other prepositions expressions with midden, or its synonyms, like in het midden van ‘in the middle of’ or te midden van ‘in the midst of’ might behave differently. The distinction in (13) concerns the modifier midden.
b’  ≠  Anna is deel van het kabinet.
   ‘Anna is part of the cabinet.’
   (no spatial inclusion)

4.2. Dependent and independent regions

The existence of crowds depend on a set of people being in a particular configuration. The membrane function maps from a set to a region. The parts come first and the whole depends on those parts. Clubs, on the other hand, can have an existence that is more independent of their parts. The members function maps a collective whole to the people that are members of it. The whole comes first and the parts depend on it. See Joosten and Vermeire (2006) for a similar distinction among collections (using the terms “bottom-up” and “synthetic” versus “top-down” and “analytic”).

One result of this difference is that clubs can have names, as in (16), something which is inconceivable with crowds.

(16)  de familie de Wit ‘the de Wit family’, het kabinet Rutte ‘the Rutte cabinet’, Hervormd Kerkkoor Urk ‘Reformed Church Choir Urk’

Clubs are also more than just a contiguous set of people, like crowds are. Clubs can have social structure (Ritchie, 2013) with roles (e.g., a chairperson), and entities (regulations, repertoire, weapons, ...). Clubs can also be ‘vacant’ (e.g., a choir without members), but crowds cannot (e.g., there is no queue without people). There can be different clubs with the same elements (e.g., a programme committee and a exam committee with the same members), but the same group of people queuing before the door on different occasions, is the same queue. This makes sense if the identity of crowds is based on their parts, but the identity of clubs is based on their whole. This property of clubs is what Gil (1996), writing about collective nouns in general, calls non-additivity. When two crowds merge the result is one crowd, but this does not happen the same way with committees or other club type collections.

There is also a grammatical effect of this distinction, seen in pseudo-partitives (Joosten and Vermeire, 2006).⁷ Dutch has two pseudo-partitive constructions, one with the preposition van ‘of’ (17a) and one without it (“juxtaposition”) (17b).

(17)  a.  een comité van deskundigen
       a committee of experts
       ‘a committee of experts’

       b.  een menigte Ø deskundigen
       a crowd experts
       ‘a crowd of experts’

Using large corpora, Joosten and Vermeire studied the distribution of 134 collective nouns (with both animate and non-animate elements) over these two constructions.⁸ The human

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⁷ See Matushansky (2017) for a recent general discussion of syntactic and semantic aspects of pseudo-partitives.

⁸ The human
collective nouns from their data set are reproduced in (18), in the categories that these authors distinguished.


In category (18a), we find no clear instances of crowd nouns (i.e., referring to spatially or temporally defined collections), and in category (18c), we find no clear instances of club nouns (i.e., referring to socially defined collections). The typical crowd nouns always allow juxtaposition (i.e., they are found in category (18b) and (18c)) and the typical club nouns always allow a preposition (i.e., they are found in category (18a) and (18b)).

There are different ways to implement this difference at the syntax-semantics interface, but the underlying idea is always that crowd nouns are more dependent on a specification of their elements than club nouns. Joosten and Vermeire (2007) offer an iconicity-based account (closer syntactic dependency mirrors closer semantic dependency). Seen from another functionalist (economy-based) perspective, the preposition is missing with those collective nouns that occur more frequently with a complement (leading to a shorter construction for a more frequent occurrence). A more semantic (not incompatible) way of approaching the difference is by allowing only some collective nouns (including the crowd nouns) to have an

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8 They also looked at the distribution in compounds, but those results will be ignored here.
additional functional type that allows them to take their nominal complement directly as an
argument, as in (19a), without the help of a preposition. Other collective nouns (including
most club nouns) do not have this functional type and they need the preposition to connect
the collection to its members, as in (19b).

\[(19)\]
\[
a. \ [ \text{menigte} ] ([ \text{deskundigen} ] ) = \\
\lambda P \{ \langle X, c \rangle : P(X) \land \text{human}(X) \land \text{membrane}(X) = c \land \text{crowd}(c) \} ( \text{*expert} )
\]
\[
b. \ [ \text{van deskundigen} ] ([ \text{comité} ] ) = \\
\lambda C \{ \langle X, c \rangle : \text{*expert}(X) \land \text{members}(c) = X \land \text{C}(c) \} ( \text{committee} )
\]

As a result, the compositional direction of application differs between crowd and club nouns,
because of how the \text{membrane} and \text{members} differ in their directionality.

4.3. Club/crowd ambiguities

The lists in (18) already reveal that some nouns occur with different meanings and in
different categories. The noun \textit{bende}, for instance, has a more basic club type meaning
(‘criminal gang’, (20a)), but it can also have a non-criminal crowd type meaning (20b), and
the use of the preposition corresponds with the nature of those two meanings.

\[(20)\]
\[
a. \ \text{een bende (van) valsemunters} \ (\text{a club type noun}) \\
\quad \text{a gang of counterfeiters} \\
\quad \text{‘a gang of counterfeiters’}
\]
\[
b. \ \text{een bende (*van) scholieren} \ (\text{a crowd type noun}) \\
\quad \text{a gang of pupils} \\
\quad \text{‘a troop of pupils’}
\]

We see something similar with the nouns \textit{club} (social club or crowd), \textit{kring} (spatial circle or
social group), \textit{leger} (army or crowd), \textit{legioen} (military unit or crowd).\footnote{This (irregular) polysemy is independent of the (maybe more systematic) polysemy that we find for a word like \textit{church}, between the building, the institution, and the people.}

Whatever the (metaphorical or other) meaning shifts involved might be, this ambiguity is
another piece of evidence for the crowd/club distinction and the differences that accompany
it. It is therefore not an accident that the noun \textit{kring}, for instance, can be disambiguated in the
kind of contexts that we discussed earlier in this section. For example, the spatial meaning of
\textit{kring} correlates with the posture meaning of \textit{zitten} (21a), while the social meaning correlates
with the non-posture meaning (21b).

\[(21)\]
\[
a. \ \text{in een kring zitten} \ (\text{a crowd type noun}) \\
\quad \text{‘to be part of a circle, sitting’}
\]
\[
b. \ \text{in een kring zitten} \ (\text{a club type noun}) \\
\quad \text{‘to be part of a church group’}
\]
5. Singular versus plural behaviour

Crowd nouns are a proper subset of a wider class of collective nouns that has been distinguished in Pearson (2011) (as ‘collection’ nouns) and Henderson (2017) (as ‘swarm’ nouns. Both authors also include non-human and non-animate types of collections in their types (like bunch or bouquet). Both authors also make the claim that the type they identify does not have plural reference (in contrast to a club type noun like committee). Pearson claims that her collection nouns do not allow quantification over elements and Henderson that his swarm nouns do not allow plural anaphora. If they are correct, then there is another important difference between crowds and clubs: crowds are more singular (more atomic) and clubs are more plural (more like sums) in their behaviour. Let us consider their arguments more closely.

Pearson points out that (22a) quantifies over any part of the wall (and not only individual bricks), while (22b) quantifies only over individual committee members. Interestingly, (22c) also quantifies over any part of the bunch (not necessarily individual flowers), leading her to the conclusion that the bunch of flowers has an atomic denotation (like does the wall), but that the committee has a plural denotation. However, notice that in (22d), with the noun crowd, there is also quantification over individual persons in the crowd, even though crowd would not be a committee-type noun.

(22) a. Half of the wall had been painted yellow.
   b. Half of the committee had been painted yellow.
   c. Half of the bunch of flowers had been painted yellow.
   d. Half of the crowd had been painted yellow.
   (Example a-c from Pearson, 2011, pp. 161–163)

Henderson points out, the committee (23a) but not the bouquet (23b) can be an antecedent of the plural pronoun they. He already points out himself that (23c), with the noun swarm, is a problem for his predication that committee and swarm should behave differently with respect to plural anaphors.

(23) a. The committee is in the backyard. They are by the river.
   b. The bouquet is in the backyard. #They are/It is by the river.
   c. My guess is the swarm will mate, dig down to wherever they lay their eggs, then die.
   (Examples from Henderson, 2017, p. 170)

The crucial factor that needs to taken into account here is that (22d) and (23c) involve collections that have animate elements (of human beings in (22d) and of animals in (23c)). It is this animacy that allows collective noun phrases to have plural reference (de Vries, 2015). If we take this into account, then we must conclude that the club/crowd distinction does not involve a plural/singular distinction. There are really two independent dimensions that are relevant for collective nouns (see Table 1), one involving the nature of the collections they denote and the other the nature of the elements of these collections.
Table 1: Two dimensions of collectivity

<table>
<thead>
<tr>
<th></th>
<th>social collections based on membership</th>
<th>spatial collections based on contiguity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>animate collections</strong></td>
<td>club, committee</td>
<td>crowd, swarm</td>
</tr>
<tr>
<td>→ plural behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>inanimate collections</strong></td>
<td>?</td>
<td>bouquet, bunch</td>
</tr>
<tr>
<td>→ no plural behaviour</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This raises the question whether we have social collections that can have non-animate members (the question mark in Table 1). At first sight the answer must be negative: since members are always human, there can simply be no inanimate collections based on membership. However, the question remains whether there might be sets of objects that form socially instituted collections (instead of just being in a spatial configuration). Take a deck of cards. The ‘non-additivity’ is obvious: we cannot just bring together a set of playing cards and form a deck of cards; a deck of cards is different from a pile of cards in that it needs to have certain types of cards in order to form a complete deck. What constitutes a deck of cards is a matter of social convention. And this shows that we have potential candidates for that fourth cell (with an appropriate generalization of the relevant notion of social ‘membership’ of objects in such collections). Whether this type of inanimate collection can be empirically distinguished from other inanimate collections requires further research in that direction.

6. Conclusion

We have seen in this paper that there are at least two ways of forming collections, either starting with a set and forming a whole (using the **membrane** function, forming crowds, with contiguity over a suitable underlying dimension) or by starting with the whole and associating it to its members (using the **members** function, applying to clubs, based on a social notion of membership).

We have to realize that this is only a very partial typology because we have basically compared two proper subsets of a wider set of collective nouns (both animate and non-animate). We have left out a discussion of collective nouns based on a specific cardinality (**couple**, **triumvirate**, **quartet**): it is not clear how they fit in and, more generally, how cardinality comes into the picture. Cardinality seems to constrain both types of collections: we have **elftal** ‘football team’, **echtpaar** ‘married couple’, **kwartet** ‘(musical) quartette’ as examples of clubs, but **drietal** or **trio** can also be used to refer to three spatially contiguous people.

The distinction between clubs and crowds made here (mainly on the basis of Dutch data) aligns with earlier distinctions in the literature (Dočekal & Wągiel, 2018; Henderson, 2017; Joosten, 2010; Pearson, 2011) and that literature is also based on data from Czech, English, and Polish. The question is how the club/crowd distinction is reflected lexically and grammatically across different languages and whether this happens in the same rich way as it happens in Dutch.

We saw that the club/crowd distinction is not a binary matter. Collections might be club-like or crowd-like to varying degrees, depending on the way underlying conceptual factors come
together, maybe in interaction with the linguistic and non-linguistic context. This is another area that deserves further empirical study.

Finally, the way clubs and crowds have been provisionally modeled, as pairs of a set and an atom, needs to be worked out in a way that does justice to the complexity of the ontology and semantics of number, as reflected in the literature (e.g., de Vries, 2015, and references given there). Also, the social nature of clubs needs to be worked out in a way that makes clear how it might relate to the notion of role, as it comes up in the treatment of Landman (1989) and Zobel (2017) of nouns like judge. An individual role, like that of a judge, is similar in some respects to a collective ‘role’ that a set of people play as a committee, for instance. Ideally, we would want one social ontology of roles (Anderson, 2018), providing us with the building blocks for a semantics of committee (collective role), as well as chair (individual role). And hopefully such an ontology can also clarify how such roles relate (conceptually or metaphorically) to spatial regions and positions in such a way that we can have a unified semantics of collective nouns.

References


